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This is the first in a series of books that will deal with different aspects of teaching and learning in higher education, such as students' learning and individual differences, teaching methods, and new teaching techniques. Four papers examine general objectives in higher education and relate them to techniques of evaluation and teaching methods. The papers acknowledge that some recent modifications of curricula and methods arise from considerations of certain objectives in university teaching, but attempt to demonstrate that a more detailed analysis of purposes and aims in teaching would not only be profitable but will soon become essential. Whether objectives are likely to be realized or not depends on a number of factors, including the way in which they are evaluated, the processes employed in learning, and the consonance of objectives with the needs and abilities of students and with the requirements of the society in which students live. These factors are surveyed in the first paper. The second discusses the evolution of educational objectives in European universities of the nineteenth and twentieth centuries. The third outlines some approaches to more detailed analyses of specific objectives, and the final paper discusses some problems of evaluating objectives in an effective way. (WM)

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S.R.H.E.
Working Party
on
Teaching Methods

OBJECTIVES IN HIGHER EDUCATION

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Ruth M. Beard
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P. J. Holloway

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OBJECTIVES IN HIGHER EDUCATION

by

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December 1968

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GENERAL INTRODUCTION TO THE SERIES

In the summer of 1966 the Society for Research into Higher Education organised a meeting for a small group of its members who had expressed an interest in studying methods of teaching relevant to higher education. Some of them were university teachers, anxious to improve their knowledge of educational theory. Others were research workers engaged in the experimental study of teaching methods, or in such fields as psychology, sociology and linguistics, who welcomed an opportunity to discuss their work with a more heterogeneous collection of interested colleagues than would normally have been easily accessible to them.

From this discussion group arose the Working Party on Teaching Methods in Higher Education, which has met on two or three occasions each term ever since. For over a year, meetings alternated fairly regularly between Manchester and London, with Dr. Frank Healey looking after matters of organisation in the north and Dr. Ruth Beard in the south. The SRHE and its Working Party owe a great debt to them both but in particular to Dr. Beard; for, later, when Dr. Healey himself moved south, the whole burden of organisation fell on Dr. Beard, and that at a time when she was heavily involved in the production of her own monograph, Research into Teaching Methods in Higher Education.

Following a number of discussions, the group decided to plan and to write a book on teaching and learning in higher education. In view of the interests and expertise of the group they felt that this should be something more fundamental than 'tips for teachers' but that experimental evidence and theories should be considered where these were relevant. Further discussion convinced all members of the Working Party that it would be advantageous to define learning in terms of change in behaviour and to limit the use of the term 'education' so far as possible, for this is an emotive term lacking a precise connotation. It can be agreed that education is a process of change and that sometimes, at least, changes are mediated by an educator; but it is difficult to distinguish between spontaneous developments and those which are mediated. Moreover, all kinds of processes result in identifiable learning but in the absence of full information as to how learning proceeds and what are its results, it is hard to decide which of them merits an 'educational' label.

As contributions arrived it became evident that the subject was so large that it would justify a series of volumes to deal with different aspects of teaching and learning. At the present time four books are planned of which this, the first, examines objectives in higher education, relating them with techniques of evaluation and teaching methods. The coverage planned for the whole series is as follows:

1. Objectives in Higher Education
2. Students' Learning and Individual Differences
3. Teaching Methods
4. New Techniques in Teaching

but it must be stressed that this is a provisional list, since this General Introduction is being written at a time when the Working Party has by no means concluded the discussions. It will, however, serve to indicate the broad outlines of what is planned. Each book is composed of a set of papers, attributed to individual authors, who had all the normal responsibilities of their office. Contributions evolved towards their published form through a series of working drafts, which served as working papers into which criticisms and suggestions from the whole Working Party were integrated. Sometimes, as in Chapter 1 of the first volume, these contributions altered the nature of the original paper.

The priority of teaching objectives in the series does not only reflect an obvious logical sequence. Every member who has taken any continuing part in the group's discussions has come to hold the view that an adequate consideration of objectives is absolutely fundamental, that in its absence conclusions reached about methods, equipment and assessment may well be both superficial and sterile. This is important to note, since not all of them would have accepted this view when they joined the Working Party.

Finally, the whole Working Party wish to place on record their great appreciation of the help they have received from Elizabeth Bull, initially Secretary to the Research Unit on University Teaching Methods and more recently to the Department of Higher Education at the University of London Institute of Education. Without her continuous and most effective help with organisational and secretarial matters, it could not have functioned.

W.D. Furneaux

November 1968

Professor of Education,
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I would like to thank all members of the Working Party who offered detailed criticism of successive scripts, especially Professor W.D. Furneaux and Dr. F.G. Healey, and also members of staff in my own department and other readers who made helpful suggestions and criticisms. In particular, I owe thanks to Miss Elizabeth Bull and Miss Kay Pole, Secretary and Research Officer respectively in the Department of Higher Education, University of London Institute of Education and to Mr. C.E. Gimson and a colleague of his in the Department of Electrical Engineering, University College, London for their comments on chapters 1, 3 and 4, and to Professor L. Perry of the University of Warwick, who read and commented on the first draft of chapter 3. I am also very grateful to Miss Bull and to Miss Angela Harley for their help in typing the successive, increasingly lengthy, typescripts.

RMB

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FGH
PJH

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Chapter 1. CHANGING OBJECTIVES IN HIGHER EDUCATION

Ruth M. Beard

Section I : CURRENT APPROACHES TO ANALYSIS OF OBJECTIVES

Introduction

A common reply when a university teacher is asked what are his objectives in teaching is that they are to interest his students and ensure that the subject matter is understood. It is rare that he elaborates this in terms of information, abilities, skills and attitudes which the student needs to acquire. Of course, it is well known that one objective is to cover certain content which is embodied in a syllabus; but since this normally takes the form of topic headings it is still too vague to tell us exactly what skills and abilities students should attain. Some investigators have begun from the opposite end, as it were, analysing the content of examination papers in an attempt to deduce the examiners' objectives. In these cases it has usually been found that students were predominantly required to regurgitate knowledge, to describe well known materials or experiments, or to solve familiar problems. Less than 30% of each paper required genuine thought on the part of candidates, by obliging them to attempt unfamiliar problems or by demanding the capacity to interpret or evaluate date, views or conclusions(81).

The well-known lament of some university teachers, that students concentrate only on learning for examinations and do not 'learn the subject for its own sake' suggests a divergence between what is tested in examinations and attainments which university teachers believe necessary for genuine understanding of their subject; but, since it is the teachers who set the papers, any such difference is most probably due to their failure to analyse objectives in the course and to ensure that each is evaluated.

Although some recent modifications of curricula and methods arise from considerations of certain objectives in university teaching, we shall, nevertheless, attempt to demonstrate in this short book that a more detailed examination of purposes and aims in teaching would not only be profitable but will soon become essential. Pressures to change curricula, courses or teaching methods are increasing as new techniques become available, as subjects develop or merge and with the changing demands of industry; while the need to consider efficiency in teaching will be forced on us by administrators who supply expensive equipment and space, and by economists who count its cost. Since these changes are likely to accelerate, objectives will have to be specified flexibly and in sufficient detail to enable teachers and administrators to predict the effects of alternative policies.

Whether objectives are likely to be realised or not depends on a number of factors; the way in which they are evaluated (for objectives which are omitted from evaluation tend to be neglected in teaching and learning), the processes employed in learning, and the consonance of objectives with the needs and abilities of students as well as with the requirements of the society in which they live. In the first chapter we survey some of these factors briefly while in the second the development of general objectives in the nineteenth and twentieth centuries is considered. Some approaches to more detailed analysis of specific objectives are outlined in Chapter 3 and the problems of evaluating them adequately are discussed in the concluding chapter.

1. Recent changes in higher education

(a) Introduction of flexible courses

A well-established trend in higher education is the development of broader courses which provide opportunity to specialise in one of two different directions, as in Combined Honours courses, or which give opportunity to students to reconsider the direction in which they specialise. As new subjects develop and well-established ones change in content, the need for a broader-based education inevitably increases; for example, medical and biological students increasingly need mathematics or physics and designers nowadays require a knowledge of statistics. There is, therefore, a growing need for flexibility in planning courses so that needs can be met as they arise rather than when an accumulation of problems and discontent makes some action inevitable; it is also necessary to provide professional men and women with a sufficiently broad base of knowledge to be able to adjust to new subject matter, or new subjects, throughout their careers. The most thorough-going attempt is in the Foundation Year and broadly-based degree courses at the University of Keele; but other universities are insisting that students should study groups of related subjects, so avoiding a too-narrow specialisation and reducing difficulty in communicating with specialists from other fields.

Another way to achieve flexibility is obtained by new B.Sc. courses which permit students to select 'units' for study (22). In one such course, a course-unit is defined as one third of the amount of work which any adequately-prepared student can reasonably be expected to complete in a year; that is to say, one third of the total work which every student who is capable of obtaining a degree at all should be able to manage. In order to obtain the degree a student must complete courses valued at nine course-units and must satisfy the examiners as to the value of eight. Able students, however, may be allowed to study as many as twelve units. In this way, students have flexibility both as to content and extent of their studies. Students may combine studies of chemistry with that of textiles, emphasise mathematics but do some physics, or vice versa, or study an equal number of courses in each, a physicist with an interest in biophysics may take a suitable course in biology or biochemistry, and so on. Honours are attainable either by high performance on the minimum number of course-units or by a lower standard in a larger number.

In a department of physics (34) a and b courses are provided each year with an overlap between successive years so that a student is able to choose harder courses in those topics in which he excels but to be less ambitious in others. A system of credits in assessment for course work, essays and open-book oral examinations, reports on experiments and a project, as well as examinations at the end of the sixth and ninth terms allows for a variety of assessment, covering a range of objectives in teaching, in addition to permitting different emphases - and to some extent different standards - among the students.

Thus, although the traditional pattern may be retained in teaching, if it is desired, a considerable degree of student choice is allowed for.

(b) Coordination of interests

In some fields a wider outlook is felt to be necessary as specialists consider the needs, or wishes, of the people for whom they cater or the interrelated services which other specialists provide. Students of law now study some aspects of sociology, student engineers undertake projects in which they become more aware of the interconnection of technical questions with social, political and economic ones, while some medical schools have recently established departments of epidemiology or social medicine which are engaged in studying the lives and problems of local people. In one engineering school an experiment is in progress in which groups of third year students are asked to examine a social or economic question to which engineering techniques can usefully be applied (12). An important secondary aim of this scheme is to provide an opportunity to organise and carry out a cooperative investigation of some complexity. Topics which have so far proved most successful include:

(i) A large electrical firm is investigating the possibility of setting up manufacturing facilities in Trinidad (West Indies). Draw up a report recommending a suitable project.

(ii) Examine the economics of providing a secure electrical supply in England and Wales.

(iii) Recommend a suitable transport system for use between Central London and London Airport.

In an end-of-term inquiry more than half of the students reported that they learned about the problem of coordination between bodies working on different aspects of the same problem while more than a third pointed out additional benefits in learning the best ways of collecting and clarifying information and what made for more effective oral reporting in a group.

An increasing need to prepare students to cooperate with specialists in other fields is also felt by the architects who, in planning a new town, for example, must cooperate with local authorities, engineers or borough surveyors as well as colleagues, builders and clients; or by doctors in large town practices who need to cooperate with personnel in a number of ancillary services. These requirements are reflected in experimental projects in some schools of architecture and in the experiences planned for trainee general practitioners. In almost all professions individuals are called on to cooperate to an increasing extent, perhaps by working in teams, or in communicating information to committees consisting of specialists in other fields who make different assumptions, employ different concepts, have somewhat different modes of thinking and unfamiliar biases. Moreover, the widespread uses of new techniques of communication, in particular television, emphasise the need for greater skill in oral reporting, or in discussion, as well as the acquisition of some general knowledge of other fields. It is, therefore, of some importance that communication skills should be fostered in the majority of university courses.

(c) Fostering inventiveness

Pressures from science and industry are producing changes in teaching. The need to encourage flexibility and inventiveness in young people has led to revision of whole courses and, in particular, to the development of programmes of laboratory experiments which are genuine problems; in this way students learn how to ask leading questions, to consult books and journals, to set up their own experiments which they discuss with fellow students or tutors and, finally, to make a full report of their failures and successes. Teachers find that involvement in planning experiments leads to greater enthusiasm and that at the end of the course their students have learned the essentials of a scientific approach in a way which those who merely repeat well-known experiments may never do. Students will soon enter university who have already experienced similar teaching, e.g. by learning from discovery methods in primary schools (103) and from experimental programmes such as the Nuffield Science programmes in secondary schools. It seems probable that they will increasingly demand to take the initiative in university work and will develop a greater aptitude to do so.

In a department of chemistry (65) research projects are now set to undergraduates. It is reported that students become more highly motivated and that some projects have proved so successful that they have been worthy of publication in academic journals. Similar reports have been given of research projects as part of a clinical course in a medical school (123) and elsewhere (34).

(d) Catering for individual differences between students

Probably one of the greatest advantages of all courses which employ projects or 'open-ended' experiments of the kind we have just described is that they cater for differences between students, since each individual can follow his own chosen procedures and may sometimes select his own projects. In courses of industrial design, students follow their own bent from early in the course, choosing projects in agricultural design, household design and so on. Where such a variety of projects is possible it is important that objectives of the courses should be specified in terms of the procedures and strategies students must learn, instead of in terms of content. But there is already a trend to specify objectives in these ways in a number of fields, for content changes so rapidly in many that it is grasp of principles and methods of applying them to solve unfamiliar problems which are now most important.

It seems likely that this new approach to teaching heralds a revolution similar to that in many primary schools where learning by rote and drill in factual materials during class-work have now largely given way to group and individual projects. This alters the function of the teacher from that of the authority who dictates exactly what content shall be learned, and when, to a guide who plans activities and answers questions but leaves some initiative to the learner in acquiring the necessary skills. The latter tends to be a more difficult and demanding role but it is generally found much more rewarding. It is of interest that one of the demands of some dissatisfied students is that they should have more autonomy in their studies.

2. Systematic analysis of objectives in planning courses

New ways of analysing entire courses, based on the methods of occupational psychologists, have already been employed in a number of American schools and colleges. Similar methods are just beginning to be used in higher education in Britain. The essence of the method is to specify objectives of the course in terms of the behaviours students will acquire in relation to the 'inputs' such as resources in manpower and materials, the media and modes of communication and the initial state of the students. Psychologists and teachers then attempt to arrange the objectives in a best order related both to the structure of the subject and to students' learning, e.g. from concrete to abstract or from specific cases to generalisations, and so prepare an outline of the course exhibiting successive objectives. This serves as a 'syllabus' which is available both to staff and students. Finally, they decide how the desired behaviours will be recognised and how to evaluate them. Thus it is not sufficient to say that the students will 'understand' the subject for this does not provide an exact description of their changed behaviour. Instead, we should specify that they shall be able to recognise certain phenomena, to translate statements and principles into other terms, act on them or apply them. Or we should expect them to learn to interpret data, to analyse it or to interpolate where there are gaps in a sequence or to go beyond what is given by predicting further results. Thus we demand that they should show awareness of applications, consequences, corollaries, etc. in accordance with the conditions described, or with those which they themselves have deduced. It will be appreciated that this kind of analysis does not necessarily lead to highly 'mechanised' courses depending on machines and computers but may serve equally as an informative guide to courses in which objectives are achieved mainly through projects, experimental work or creative writing.

An example of an analysis of an Industrial Design Course serves to show just how informative and flexible the resulting plan of action can be (99). The psychologist and teachers planned their analysis in six steps. Ideally there would have been an initial study of the work of designers in order to determine objectives in teaching but, owing to lack of time and money, objectives were defined during discussions between practising designers and those in the school. Secondly, the objectives were specified in terms of behaviours the students would exhibit at different stages, e.g. in identifying problems, four levels of behaviour were outlined for the successive years of the course. Relevant stages were also identified in the writing of reports and in making systematic solutions of problems, etc.

Thirdly, these achievements were broken down to see in what ways they could be attained. Fourthly, the psychologist and teachers decided what contributions could be made to the course by each discipline. Fifthly, they prepared a chart, showing the required performance in each discipline at different stages in the course, which served in lieu of a syllabus and timetable to staff and students alike. Finally, they estimated the time required for a class of students to match the stated criteria and arranged some latitude for repetition.

The resulting course is basically a series of projects. The timetable does not state what will be designed but it does state which particular criteria the student is to meet during his completion of that project. In this way it serves as a guide in planning courses of lectures, seminars and guided reading, so that students can be prepared for each project immediately before work begins on it.

A number of advantages are reported over traditionally conceived courses: both staff and students are more clear as to what the course is designed to achieve; it can be readily adapted in response to developments; the task of assessing students' progress becomes more meaningful for it is possible to devise objective measures of the degree to which performance criteria are being met. Since the timetable is not a list of lectures etc., and teaching methods can be kept flexible, all that is required is that a given performance should be attained in a given time, by any method which the member of staff considers most suitable.

Some physicists have demonstrated that they too can make effective use of operational research techniques by using network analysis to guide research students in designing a research project. The initial network shows the steps from specification of the problem in general terms to the report of results and indicates an approximate time scale. Subsequent networks take each step and break it down further into interrelated sequences of activities. This serves the purpose of guiding an inexperienced student in all the steps of his research, giving him warning where he will need to make preparation in advance and ensuring that he will not overlook any essential procedure. The authors find that a programme of this type "enhances the efficiency of all those concerned with the project by avoiding unnecessary effort and making it possible to plan technical assistance. It permits a continuous assessment of progress and should advance the time at which a student reaches the critical stage when he produces more ideas than are provided for him." A consequence of setting out the research programme as illustrated in Figure 1 is to show the director of studies that there is a limited range of investigations that can be successfully completed by a student who has only three years in which to learn the techniques of research and then carry out an investigation. If the apparatus is complex, the experiments must be short and assured of a positive outcome. If the experimental information required is extensive, the apparatus should be ready and in working condition for the student. If the apparatus and experimental methods are relatively simple then more time may be spent in theoretical investigations. (121).

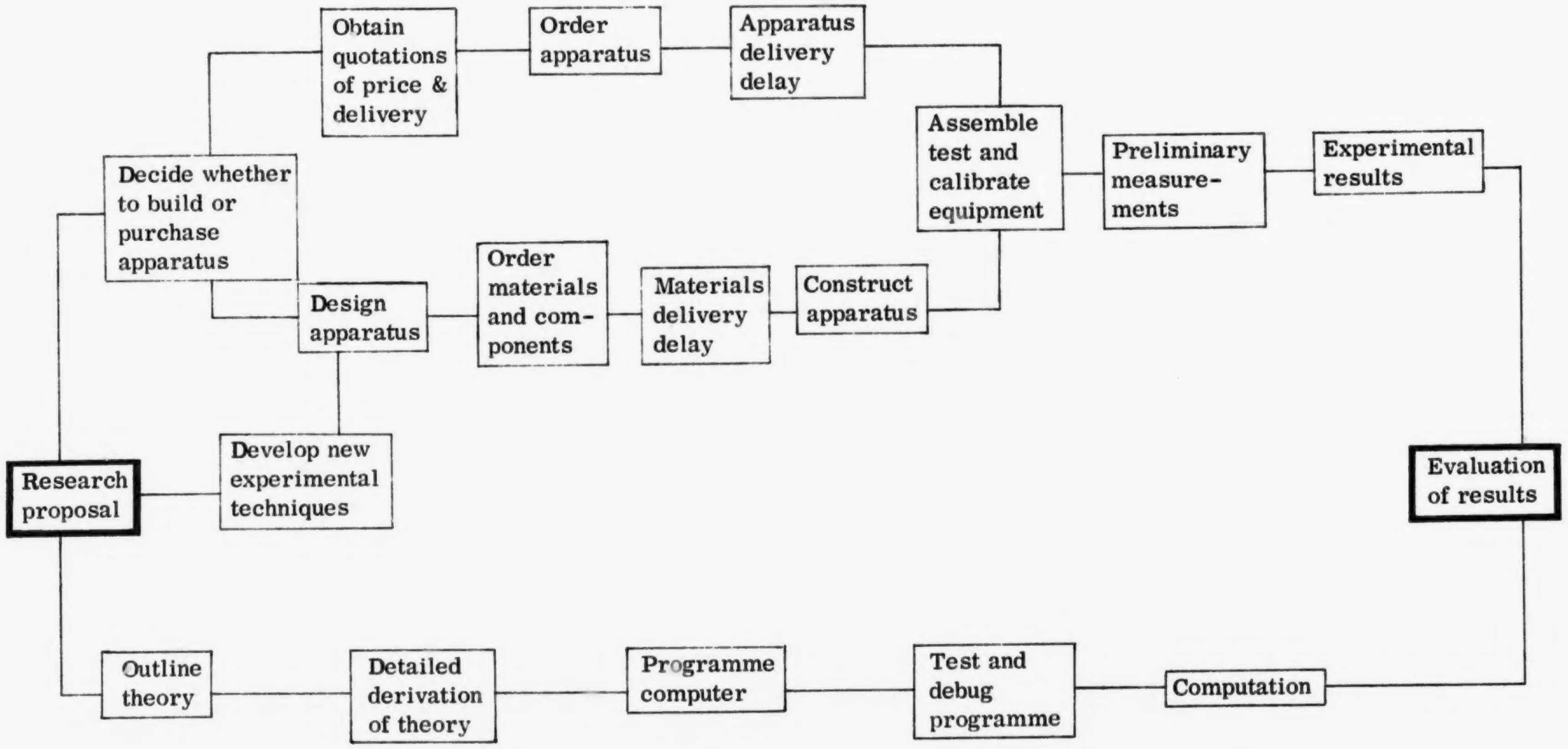
Research proposal
Decide whether to build or purchase apparatus
Obtain quotations of price & delivery
Order apparatus
Apparatus delivery delay
Design apparatus
Order materials and components
Materials delivery delay
Construct apparatus
Develop new experimental techniques
Assemble test and calibrate equipment
Preliminary measurements
Experimental results
Evaluation of results
Outline theory
Detailed derivation of theory
Programme computer
Test and debug programme
Computation

Figure 1. Stage 4. Experimental and Theoretical Investigation

Thus, like the designers, these physicists have found the value of a detailed outline of objectives in guiding both staff and students, in improving the students' performance and increasing the possibility of evaluating the action they take.

3. A suggested procedure

The first step in defining objectives is to bring together a team of 'experts'. This will include staff of the department or college and at least one occupational psychologist, or specialist in education. Thereafter, work will proceed in periods of discussion, recording findings between sessions and criticising them or developing them in successive sessions. In the first place the team will consider the nature of the subject, requirements of experts in the field when they are qualified, the initial state at entry of students to the course, and so on. This ensures that the objectives set up are related to present day requirements and are uninfluenced by content of the existing course. From the beginning objectives will be defined in operational terms and it may be profitable to consider at once how their achievement will be evaluated. In the case of industrial design we have seen that this led to viewing one course as a training in solving certain kinds of problems instead of in subject divisions. A second step may be to analyse the various skills and abilities required in the subject and to identify essential information. At this stage a decision as to the categories of objectives best suited to the subject under consideration should be made as, for example, those exemplified in Bloom's Taxonomy (18); thus 'problem solving' will be relatively unimportant in defining objectives in teaching literature, but analysis, evaluation and synthesis may well rank as important categories. From this point objectives will be specified in more detail and may extend to identifying individual steps in learning difficult topics as is the case in planning programmed texts (77).

Following this outline of the course in terms of major objectives, and of essential information skills and abilities a series of objectives are set up for different stages in the course and only then is it essential to consider how each objective will be attained. The same outline may serve as a guide to highly individual courses in which each student proceeds at his own pace or planned courses in which teachers guide students at least in attaining initial skills. In either case the outline of objectives is made available both to staff and students so enabling both to assess learning as it proceeds and motivating students by showing them what they have still to attain.

4. New audio-visual techniques and aims in teaching

The development of new techniques in itself challenges teachers to reconsider what they value most and thus wish to emphasise in teaching and learning. There is a danger that the prestige, or interest, in owning closed-circuit television or a room with teaching machines will influence judgment as to their value before it has been adequately investigated. Some university teachers, for example, hearing of the value of programmed learning, inquire about machines they should buy before investigating what programmes are available or considering whether the effort and cost of producing further programmes in a suitable form for the machine is worthwhile in their subject.

Closed circuit television has considerable value in relaying materials to a far wider audience than would otherwise be possible and in showing those which are dangerous or inaccessible except to a camera. It is also time saving since materials for different sources can be coordinated and a variety of exhibits can be assembled on one occasion; thus time can be spared for discussion which would otherwise be occupied in travelling or in further lectures. Since records can be obtained fairly inexpensively on video tape, outstanding lectures may be kept for future audiences or recordings may be made to provide feed-back to teachers and students as to their performance of some skill e.g. in giving a lecture or in making a physical examination of a patient. An accumulation of such records is valuable in illustrating good or poor techniques to other groups of students or for purposes of revision. Nevertheless, unless the apparatus is fairly fully used it may still be questionable whether it justifies the initial outlay and subsequent expenditure.

Techniques of almost universal value are those which can be used inexpensively to illustrate lectures or topics in group discussion or which can be adapted for individual study. Illustrations using the overhead projector, tapes and slides or film loops can be used in these ways. But in these cases the question is how can they be used most effectively? If used for individual study should illustrations be accompanied by questions for the student to attempt to reply to before he sees the correct answer? Or is it sufficient simply to accompany the illustrations by a continuous tape or script as is usually done? Evidence from programmed learning suggests that the former is likely to be effective. If so, for successful presentation, the teacher who devises the audio-visual aid needs to outline his objectives, to break down the learning into steps and to consider the best order of presentation, number of illustrations and so on before he prepares the tests. Perhaps, ideally, he would prepare a number of alternatives and compare their effectiveness. In any case, he would need to determine what students learned by constructing suitable tests to administer before and after use of the individual study techniques, whether they are his own, prepared by other teachers, or commercially produced. For there is a potential danger in the commercial development of audio-visual aids, for example. The business man's objective is necessarily profit despite any concern he may have that his wares should be educationally useful; he is therefore likely to be satisfied with short-term success and may view with favour kinds of learning which lead to increased dependence on his wares whether this is in the long-term interests of the students or not.

5. Developments in the economics of education

Parallel with social and professional pressures to modify educational programmes and techniques there are increasing demands from those who pay for expanding higher education that it should be efficient. This raises interesting problems for economists and others who must first define concepts which will enable them to assess educational efficiency. Cost-effectiveness analysis is the most general tool, merely expressing the effectiveness with which objectives are achieved per unit of cost. If there is more than one, objectives may be appropriately weighted. This general technique is completely neutral about objectives, and although it has nothing to do with the content of economics, it is economists who naturally think like this. However, cost-effectiveness analysis is merely a formal way of stating the characteristics of all rational decision-making. Recent development includes introduction of 'program budgeting' (48) which requires that 'outputs' or goals should be quantifiable to some extent so that projected expenditure data appearing in the budget can be meaningfully related to projected performance. This is in contrast to the conventional budget which is shaped largely by the desire to safeguard against carelessness and thus it does not allow resources and costs to be related to the specific 'outputs' or goals to be achieved. A key purpose of a 'program budget' is to facilitate judgment about 'what is the least-cost method of undertaking a given activity'. However, as yet, 'output' measures appear to be somewhat crude.

The method of analysing and relating inputs and outputs known as 'systems analysis' is now in use at Toronto University in the Faculty of Medicine (68) employing objectives defined by teaching staff. A group of 'decision makers' then evaluate the costs and benefits of alternative programmes and so can answer "What if . . . ." questions as curricula and other changes are proposed. In this instance the chief 'outputs' or objectives considered are education of health service personnel, patient care and research; the main categories of inputs are uneducated or partly educated students, academic and non-academic staff, facilities and materials and patients.

In the initial stage the purpose is to concentrate attention on the physical resources put into the system, but these are subsequently converted into monetary units.

The group of decision makers is now confronted with such problems as expansion of enrolment, increase in research, expansion of graduate studies, staffing and remuneration policy. To outline but one example of procedure given by the authors, once the total teaching load had been determined in terms of contact-hours between teachers and students the effects of different staffing policies were considered in relation to estimated increasing student numbers. Considering three staffing policies:

A - On the average 6 hours of teaching activity to be required per week per staff member.

B - Staff members required to teach no more than 2 hours per week of lectures and seminars and no more than 4 hours per week of clinics, small groups and individual instruction whichever shall be limiting.

C - Each department to require the same average number of teaching hours from its staff members as they provided in 1966-7.

It was shown that policy C necessitated significant increases in full-time staff (or their equivalents) above the levels forecast by departmental chairmen in their 1970/71 budget proposals except in Departments of Obstetrics and

Gynaecology where the needs would decline by about one quarter; whereas policies A and B resulted in substantially lower requirements than those forecast, A requiring least.

The common assumption that, if the same objectives may be obtained by an additional member of staff, more space, or an expensive piece of equipment, that the member of staff should be chosen, deserves to be examined with some care. One member of staff may be paid an average of £3,000 p.a. for 30 years, additional space may well cost about £10,000, whereas expensive apparatus, such as a language laboratory or closed-circuit television may require an initial outlay of only £4,000 although running costs and depreciation must be considered. If this is the situation, the teacher needs to be greatly superior in his effect on learning to justify so considerable a difference in expenditure.

The new budgeting is not an imminent development throughout the universities of Britain, but the interest aroused by the recent reports of Blaug (16) and Blaug and Woodhall (17) leaves us in no doubt that productivity and efficiency at all levels in education will soon be the subjects of similar inquiries. Although the indices used were experimental their observation that measurement of productivity in British university teaching between 1938 and 1962 - employing three different weighting systems to evaluate the output of students completing a course - showed a steady decline by all three methods is disquieting, especially when they report the sharpest drop in the past ten years; but one way to contest their conclusions would be to demonstrate that they had neglected some important objectives in teaching.

In planning buildings for the future, flexible designs are being advocated to allow for different uses as subjects develop or teaching methods change; and the insistent demand that space and expensive apparatus in educational buildings should be used more fully is leading to consideration of laboratories in which more than one science can be taught. There are also proposals for a six-term year (23) and for concentration of courses in a limited number of university buildings. In teaching, new techniques have been devised which allow some economy in the use of skilled teachers, such as extensive use of programmed learning (102, 116) or libraries of tapes and slides for use in private study by students and doctors at home and overseas or by those who lack access to teachers (45). There is an increased concern also with evaluation of the effectiveness of learning and teaching. This requires careful analysis of objectives both to ensure that the information, skills and attitudes of greatest importance are taught and to avoid methods of examining which neglect certain attainments or give undue emphasis to those of less importance.

Section II : THE RELEVANCE OF LEARNING PROCESSES TO THE STUDY OF OBJECTIVES

1. Varieties of learning processes

The processes employed in teaching and learning are themselves relevant to a consideration of long-term objectives, for they reflect the values of teachers and influence the attitudes to learning of students as well as partly determining the kinds of skills and abilities they attain. We will discuss some processes relevant to the achievement of educational purposes beginning with those already apparent in infancy (which nevertheless continue and develop throughout life) and proceeding to those which involve the use of symbols and abstractions.

(a) Processes which are largely unconscious

The most primitive processes in learning include the development of schemas of perception and action, conditioning, suggestion, imitation and identification. These are processes which are to a considerable extent involuntary, making minimal use of language and which therefore dominate learning until the emergence of language causes their importance in a pure form gradually to decrease.

Perceptual schemas are built up in infancy from many observations of similar events. Thus, if we look at the photograph of a boiler of a ship and see a line of small circular shapes with shadows on their lower edges we interpret them as rivets; large irregular rounds with shadows in their upper segments may be interpreted as damage from gunfire. If we reverse the picture the rivets appear hollows and the 'indentations' are now protruberances (2). All our lives we have expected light to shine from above and so we interpret pictures accordingly. Again an individual accustomed to rectangular buildings on looking into a distorted room in which floor, ceiling and walls are all trapezia is liable to interpret what he sees as a normal room in perspective (70).

Every individual has a multiplicity of such representative schemas of which he may be unconscious but without which he could not interpret the world he lives in. Physiologically their basis seems to be in the gradual organisation through repeated experiences of patterns of cellular activity in the cortex, which operate as integrated wholes. These are activated whenever the individual experiences relevant stimuli. During infancy schemas of action and perception are developed but, with the acquisition of language and ability to represent one thing by another, first representative schemas and then conceptual schemas are developed and these, in turn, are integrated into more complex organisations. The acquisition of perceptual schemas therefore is a kind of learning essential to subsequent education; but it proceeds at a level where the deliberate intervention of other individuals is unnecessary and the learner does not reflect on what he does. When in later life representative schemas are extended with the assistance of language, in learning the meaning of 'square' for example, or in interpreting diagrams and X-rays, the intervention of a teacher is practically unavoidable and the individual is aware that he learns - or that he fails to do so. Moreover, the learning process is a more complex one. It may be, however, that the kind of representative schemas developed unconsciously in infancy, whether predominately visual, or auditory and kinaesthetic, determine the directions of later learning and the choice of educational specialities. This is sometimes described as an unconscious coordination of mental schemas of action which operate in learning a skill by imitation; it is possible to develop a 'feel' for the chain of actions which constitute the skill before performing them, although of course performance is essential to expertise. Imitation is, therefore, a useful process which the learner is conscious of employing; but some imitation takes place at a less conscious level where, for example a slow worker is influenced to work more rapidly in the company of a highly practised or quicker group.

Identification appears to be more wholesale imitation of an individual having prestige or the taking over of behaviour characteristics of a group. Among students it may be at least partly a conscious process of modelling behaviour on an admired teacher or, in schools, pupils may model themselves on an older pupil. It appears that this process is used in schools which foster an ideal type, and that it is one factor in operation when a student doctor, for example, acquires professional attitudes.

Conditioning is an automatic association having direct consequences on behaviour which associationists claim to use in teaching. In classical conditioning first studied by Pavlov, an association is set up between a neutral stimulus (such as the ringing of a bell) and a reflex reaction (such as salivating on the presentation of food). This results, after several simultaneous presentations, in the neutral stimulus being followed by the reflex reaction without the presentation of the present stimulus, (i.e. the sound of the bell alone results in salivation). In instrumental conditioning an action of the animal (or human being) is instrumental in producing a 'reward' of some kind; in consequence the probability of the action being repeated is enhanced. For example, if pressing a lever more or less accidentally produces food this leads to an animal eventually 'learning' to press the lever. This 'learning' may then be utilised in a different situation. In both kinds of conditioning, therefore, reinforcement by a 'reward' of some kind results in the setting up of patterns of behaviour. In the case of programmed learning, the learner is rewarded by the satisfaction of knowing that he has made the correct response to the stimulus which takes the form of a written statement or question; thus he learns by instrumental conditioning.

The processes of imitation and identification, like suggestion, have in common that they all play an important part in learning, which usually requires human contact, but it is a part which tends to decrease with age and maturity in the learner. Some types of suggestibility appear to depend on the use of language for they develop after infancy to a maximum at about eight years but thereafter decline as capacity for critical thinking develops. However, individuals differ in the extent to which their behaviour and mental processes can be influenced without their knowledge and volition, and susceptibility varies also with the situation or with the kind of personal interaction. Although people are likely to be suggestible in relation to others with prestige this is not necessarily the case. There is some evidence that, in relation to prestige figures, people tend to extreme degrees of suggestibility, pro or contra, or none, whereas the majority of people are somewhat suggestible in situations where prestige plays no obvious part. Interestingly, suggestion which is usually verbal and spoken may be equally effective when recorded (58).

In the case of 'indirect suggestion', where the response is suggested in such a way that individuals are unaware of being directed to behave in a particular manner, up to 90 per cent of experimental subjects prove susceptible (58). When samples of students were asked to read a passage, either silently or aloud, or to prepare a talk on the same topic, those who prepared and delivered a talk were significantly more influenced by the passage than those who did not (72). This raises questions whether teachers may not suggest the acceptance of certain views merely by asking students to report on them, or to be otherwise involved in defending them, and stresses the need - where rational thinking is the objective - for presenting several views (if these exist) at one time. Perhaps the experiment 'succeeds' by the same mechanism as one of Festinger and Maccoby (38) who distracted their audience while a message unwelcome to some of them was put over. They showed a persuasive film arguing strongly against fraternities, once with and once without the addition of highly distracting material. Results indicated that those who had no strong views were uninfluenced by either presentation but that those previously committed in favour of fraternities were influenced by the film with distracting material, but not by the other, presumably because the distracting material prevented them from formulating counter arguments.

The importance of being able to formulate and present a contrary view in resisting suggestion is supported by findings which show that those who initially asserted their independence in face of views they found unpalatable tended to remain uninfluenced (41), and by a study where an inverse relationship was found between suggestibility and conscious, verbalisable resistance to test suggestions (8). In an experiment by Lorge (76) students did not, in general, base their judgments about the validity of statements on the prestige of the writers to whom they were attributed, but considered the whole context for the determination of meaning.

In group situations among students Asch has reported a 'predisposition to conform' (6); but independence of judgment had been established by about half the groups studied. He showed also that where standards of a congenial group differed sharply from those of an individual member his standards were weakened as a basis for judgment, whereas those of an antagonistic group tended to be rejected - and more decisively so in contrast with that of the congenial group than in comparison with the ego-standard; individuals whose views differed considerably from those of the congenial group were more likely to change than those who diverged slightly. (4, 5, 6).

A characteristic common to all of these learning processes is that each may have an effect either of directing or limiting learning - an individual's belief in his capacity to succeed may be undermined by indirect suggestion, he may imitate undisciplined behaviour from companions in a group, or, in childhood, he may have identified with an immature or delinquent parent or companion and, through conditioning, he may acquire stereotyped responses. Suggestion is also one of the tools in deliberate indoctrination. Since such learning is non-verbal it is relatively inaccessible to persuasion and still less to reasoning. Experimental results show that the chief defence, or remedy, is that students should develop the capacity to express resistance in verbal form. To aid this process teachers should encourage discussion of a variety of view points and help students to become more critical by being aware of their own assumptions and prejudices. In so far as more primitive learning processes are used, their function in higher education appears to be to foster confidence, to motivate student to learn, or to induce desirable professional attitudes; and, since group influences are bound to operate, the composition of groups in teaching would be likely to repay study.

(b) Processes which are conscious but automatic

A second group of learning processes is less automatic and depends to some extent on deliberate teaching. These are rote learning, following rules, training or practice which give rise to acquisition of information or skills, and - of a somewhat different nature since it may employ any of the former processes - indoctrination. A feature of all these kinds of learning is that they are limited as educational processes; the student knows something or is able to do something without knowing how, or he believes something without reason or despite information which should cause him to reconsider his belief. However, each one has a place in education; rote learning is useful in acquiring vocabulary and the alphabet, for example, and a few people excel in learning in this way; following rules is essential in circumstances when the learner must act but has insufficient knowledge to exercise judgment; practice is needed to learn arithmetical combinations and indoctrination of a kind is inevitable when children are introduced to beliefs which they are too immature to question. The value of these processes is in doubt if they continue despite the pupil's growing ability to be more critical or to learn general principles, or if they are substituted for those kinds of learning which lead to understanding of concepts, discriminations, techniques in problem solving, and so on.

(c) Learning processes which maximise understanding

The learning processes which remain are those which maximise understanding, require the pupil to act independently and to make decisions, demand flexibility in thinking or some inventive or creative effort. It is the developments arising from these processes which are increasingly required as knowledge develops ever more rapidly. Yet it is precisely at this level of complexity that there has been insufficient analysis of learning for us to pin-point the processes involved. However, we will attempt to identify broad categories which involve fairly independent activities.

A process which begins in early life and continues as long as intellectual growth continues is that of asking and answering questions. From this develops the give and take of conversation and of more organised discussion. There is evidence that this is one of the most educative processes since it enables the pupils to analyse differences in views and opinions, revising his position to integrate what he learns with what he already knows. Berlyne found that to ask questions, particularly unexpected ones, rather than stating facts, improved learning and increased interest in a topic (15). Students must learn special skills in asking questions whether they are to become scientists who plan experiments, lawyers who will try to arrive at the truth about events, or social workers or doctors who must attempt to diagnose the sources of their patients' problems or illnesses. Discussion in adolescence and adult life also contributes to the development of new concepts from already familiar ones or from those imperfectly understood in reading.

Solving problems is another process which is learned early in life; but successive problems once solved become familiar facts. In childhood, problems are largely of a kind which lead to concept formation - to recognition of ways of categorising objects or to establishing relationships between them. In adolescence, and throughout higher education, although concepts are learned they tend to be more abstract in nature and the greater part of problem solving involves the application of known principles and the derivation of more complex and general ones. At a still higher level, the principles may be inter-related in explanations or in theories in an attempt to solve yet more complex or fundamental problems.

A third process which develops throughout life is that of decision making. In this aspect, perhaps, traditional education is weak - for children's decisions are mostly made in play and are, therefore, outside the organised educational process. It is, of course, one of the virtues of the modified Dalton Plan (95) that children decide for themselves during a large part of the day what they will study, selecting from books suggested in the syllabuses provided by their teachers, and with latitude as to when to complete homework. No pupils of these schools suffer the problem of not knowing how to organise their studies on arrival at university. But this is only one example of decision making, albeit an important one. Pupils make decisions whenever they work independently in planning experiments or in producing a play, for example or whenever they are given responsibility and, to a lesser extent, they learn by seeing how decisions are made by other people. However, as with all skills ability to make good decisions is learned by practice and feed-back as to success .

In every subject there are many skills which require practice in this way, such as writing of reports, learning points of grammar, acquiring skill in speaking a language, or solution of particular kinds of mathematical problems. There is no substitute for practice with prompt correction of errors or reinforcement of correct responses. However, where teaching is poor, practice of this kind tends to occupy a disproportionate amount of time to the exclusion of the solution of learning processes which encourage greater activity and understanding on the part of the student.

Processes which contribute to personality development, to skill in communication and to intellectual appreciation are those of externalising experiences in terms of active expression. In these cases technical skills need practice, or the expression attained is likely to be inexpert but it is in trying to convey an experience, emotion or idea that the artist or writer extends his repertoire of skills and may attain a more complete understanding in criticising his own partial realisation of it.

In addition to self-expression, the processes of analysis and evaluation are used to increase understanding of construction in the arts or presentation of scientific data or theories. These are skills appropriate on the whole to at least an adolescent level of attainment for they involve appreciation of relationships within a complexity which as we shall see, is not normally achieved until a mental age of 16 or so is attained.

2. The Needs of Society

We have considered educational processes at some length because it seems to us that although certain 'primitive' processes inevitably operate in education they tend to be ignored, and because different emphases on the completely rational processes, or the less rational, are associated with the beliefs and values of different societies and sub-groups. All advanced industrial societies have common objectives in attainment of the knowledge and skills required in management, scientific and technological development, or communication, and have a substantially common heritage in the arts, and to this extent, must have very similar educational programmes and employ closely similar educational processes. Thus all these societies have many common goals, as well as common problems, evidenced at present by current student unrest on both sides of the Iron Curtain. It is at the ideological level that they differ substantially and it is in promotion of ideologies and group beliefs that the processes of suggestion, direct or indirect, and indoctrination are commonly used. Thus, in certain communities a young man may be educated as a scientist to criticise evidence, but in the social and religious fields he will not be trained to consider all the evidence, or it may not be available to him. This is highly criticised by those who feel free to study any view, but in so doing, they are accepting a value which is not self-evident and needs to be justified on other grounds. Also within a single society different institutions reflect different beliefs and, therefore, employ different processes in educating students. The contrast between the tutorial systems at Oxbridge and Sussex (when they result in genuine discussion) and the relatively slight contact between staff and students in some civic universities reflects one such difference in view.

There is, of course, a possibility in times of change that learning processes suited to a past stage in development will continue to be employed when they are unsuitable or detrimental. It seems that this is so in some departments and in some areas of higher education; there is a habitual emphasis on rote learning, practice of known problems, experiments or skills although these may soon be outdated - and too little encouragement to students to think, to devise their own experiments or to attack genuine problems. Students complain that too many teachers maintain a consistently authoritarian attitude and thus fail to encourage them to be independent or to take responsibility for their progress. At all these levels we need to reconsider objectives in higher education and how we should employ the means available to us to produce professionals competent to operate in the industrial society of the future where developments will accelerate with ever greater rapidity.

Section III : OBJECTIVES IN HIGHER EDUCATION

Objectives in providing higher education are necessarily largely determined by the society it caters for. In communities where only some people receive formal education, or where an élite receives a superior education, its purpose is to prepare them to be reasponsible both for government and the advancement of knowledge. In Britain, until after the First World War, this was an education based on the classics in conformity with existing social ideals; the 'educated man' was, therefore, almost synonymous with the product of Oxbridge. Today, when everyone receives at least ten years of formal education, higher education follows both on social advantage and on evidence that the individual has capacity for higher intellectual attainments, and a man may be considered educated though he has no knowledge of the classics. The present purposes of higher education are to produce individuals, expert in various specialities, to maintain and develop the economy and to advance knowledge in an increasing number of fields. But as the number of specialised fields increases so does the importance of communication and this may lead to problems if higher education is not sufficiently broadly based. These are likely to be particularly acute in Britain where specialisation begins in the schools and is more complete than in any other industrial country.

1. Common Educational Attainments

That there are nevertheless certain general higher educational attainments was shown by the empirical investigations of Piaget and Inhelder and, despite early specialisation these have been confirmed in Britain (86, 96). They found that the educated adolescent (with mental age of some 16 years or so) attained a number of characteristics in his thinking which were superior to those of children.

The process starts - and Piaget believes that this may be essential to the other developments - when the adolescent begins to see himself in relation to other persons and to appreciate the validity of their different views; he therefore becomes capable of making objective judgments and it is a short step to making assumptions and to deriving their consequences as he needs to do in science and in logical argument. This therefore, is a capacity which resembles Peters' 'respect for others' (97); but the latter is based on a concern for other people in addition to the intellectual component of simply seeing that other views exist than the individual's own. Thus if Piaget is right that this capacity precedes other higher developments in thinking it must be only the intellectual component that is essential, for some who lack concern do achieve intellectual eminence, and history would be deprived of its autocrats and manipulators of other men if respect for others had been a condition for intellectual superiority.

Secondly, the educated adolescent seeks general laws and principles; for example, he finds common meanings to proverbs and understands some more complex principles in science and mathematics. However, observation suggests that at the university less able students often cannot select appropriate principles or generate new ones whereas the honours student may excel in these respects. Thus, in teaching at this level one objective may more properly be to enable students to select from a repertoire of principles in solving or discussing varieties of problems than merely to apply known principles to problems of stated kinds.

Thirdly, the educated adolescent takes a broader view than a child; he considers different aspects of a case, gives exhaustive definitions and no longer makes moral judgments in black and white terms. Failure to develop in this respect may be one reason why some students give descriptive answers to questions they are required to discuss. It is possible that concentration on physical sciences and mathematics encourages students to look for the one right approach or one correct answer (at least as these subjects are frequently taught). One of the writer's students who had a third-class degree in mathematics, but many practical interests, observed that he was not in the habit of looking at different sides of a question. He had been puzzled when a descriptive answer to a question he was required to discuss had received a poor mark, but he realised suddenly that he had this particular deficiency. This instance suggests that a too narrow specialisation, or a too narrow approach in teaching, may limit capacity for higher attainments in thinking.

Fourthly, adolescents learn to use some complex relationships such as proportionality, correlation and probability, or relationships within a complexity when sifting data, in planning experiments or following events in history. In addition, capacities specific to certain fields are attained: e.g. in solving problems of a scientific nature the adolescent at this level sees the need to alter one variable at a time, sets up his own experiments and tests hypotheses he makes, thus developing an increasing capacity to organise his thinking and to argue deductively.

Overall the thinking of the adolescent is more abstract than that of the child. He thinks in verbal and symbolic terms, arguing in propositions, and goes beyond the concrete, tangible and finite to deal with the intangible, infinite or imaginary. His behaviour becomes increasingly guided by principles which he has thought through. Nevertheless, findings in a study of understanding of television programmes (111) show that even highly intelligent and well-educated adults understand better a concrete, rather than an abstract, approach. Thus in teaching new topics even at university level an initial approach through concrete examples is likely to facilitate later understanding of abstractions.

2. Individual differences and objectives

Since Piaget and Inhelder did not investigate the thinking of adolescents older than sixteen years they had no opportunity to trace the development of ways of thinking specific to certain domains or to study highly original and complex thinking in young adults. For example, no one has studied the effect of specialising in one field on thinking in others; but the tendency to fail to comprehend each other observed among some specialists, e.g. some surgeons and psychiatrists, or physical scientists and social scientists, suggests that a highly specialised education may limit ability to communicate with people from other fields or alternatively that a personality factor operates in the original choice of speciality and simultaneously causes antipathy to extremely different ones. A number of philosophers claim to have distinguished between different domains of knowledge in terms of different bodies of concepts and modes of thinking. Initially, Peterson listed the lyrical, empirical, moral and aesthetic as the main modes of thinking (98). Hirst (51) suggests that the distinct disciplines or forms of knowledge are mathematics, physical science, human sciences and history, religion, literature, the fine arts, and philosophy together with moral knowledge and that these at the present time basically constitute the range of unique ways we have of understanding experience. Historically, he considers, there has been a progressive differentiation, the most recent division being between religion and morals, but as bodies of concepts are developed in new fields additional domains of knowledge are likely to evolve.

Broad differences in ways of thinking between specialists in sciences and arts or social sciences, have been found in English VIth formers by Hudson (57) who identified them as 'convergent' and 'divergent' thinkers. Their characteristics were reported as follows: "the converger enjoys thinking about technical, impersonal matters. He likes argument to be clearly defined and logical, and to know when he is right and when wrong. He is not interested in probing into topics of a personal, emotional nature, nor in controversy. The diverger is the reverse, he likes discussion to be personal, he enjoys controversy and uncertainty. On the other hand, he is not interested in the technical, nor in argument which is purely a matter of impersonal logic". The former type tends to elect to study the physical sciences whereas divergers more often choose the arts or social sciences. People who make decisions based on probabilities before it is clear whether their decisions are good ones may tend to be divergers.

To what extent these differences are educationally determined is difficult to say. Possibly they are determined more by early upbringing or even by innate differences. But, since most differences between individuals are modifiable by education we should infer that a broadly based education will serve to reduce the number of extreme convergers and divergers, whereas their number will be greater among students who had specialised very early in arts or sciences. When specialisation takes place, as it must in many courses, the necessary emphasis on certain kinds of concepts, modes of communication and expression, and criteria for distinguishing true from false, or good from bad, almost inevitably lead to biases in thinking. However, it will be interesting to see whether broader based courses, such as the Foundation Year at Keele, result in a greater ability even on the part of average students to communicate with those in other fields.

Individual differences in perceptual type possibly of a fundamental kind, since they are related with wave patterns of brain activity, have been demonstrated by Grey Walter (117). In 1943 he found that individuals with persistent alpha rhythms, which were hard to block with mental effort, tended to auditory, kinaesthetic, or tactile perceptions rather than visual ones. In this group alpha rhythms continued even when their eyes were open and their minds were active or alert. A second group, who showed no alpha rhythms, conducted their thinking processes almost entirely in visual terms; whereas the remainder of the sample, whose alpha rhythms began when their eyes were closed and their minds relatively inactive, employed all modes of perception. The proportion of individuals using visual perception almost exclusively proved somewhat higher in science students than among those specialising in arts; they were quick in solving problems which could be readily visualised but when faced with an abstract problem or ones which they found too complex to visualise adequately, they became 'sluggish and confused'. Since the majority of children are visualisers it will be of interest to know what are the results of experiments in which the development of thinking and perception as well as alpha activity is followed with a view to determining to what extent these also are influenced by experience.

Other factors which may well influence choice of speciality and of biases in thinking are such special cognitive abilities as speed and skill in calculating, verbal fluency, spatial imagination, verbal and non-verbal reasoning, perceptual speed and so on, which some psychologists identified in the 1930's and 1940's (114). Personality factors such as introversion-extraversion must also lead to educational choices which eventually, if not initially, are associated with different modes of thinking.

Since individual differences are so great there seems to be a case for greater flexibility in courses and in teaching. There is already a movement in this direction in the development of new kinds of combined courses and by allowing students to select subjects for projects and researches or in solving open-ended experiments; but there are still too many institutions where all students are expected to attend identical courses, to learn in the same way and to work at the same price.

3. Varieties of higher education

Findings relating to the development of thinking, and of different varieties of thinking in adolescents, or among kinds of specialists, enable us to consider objectives in higher education in a more informed way. In the second chapter, nineteenth century views are discussed, in particular those advocating education in the liberal arts and the utilitarian view. The former was an education for the gentleman who did not require to earn a living, whereas, in contrast, the utilitarian reflected the attitudes of the rising industrialists and stressed the value of education in mastering the environment and advancing technological progress. Today a purely 'utilitarian' view, as such, is rarely expressed; instead vocational training is more likely to be contrasted with an enriched conception of a liberal education. For example, Peters (97) suggests three conditions which a higher education should satisfy in order to be 'liberal': study of the subject matter should be worthwhile in itself, there should be an emphasis on rational thinking, judgment and criticism and it should not be restricted to a specialist training or to one mode of thought.

In discussing higher vocational education, Oakeshott (92), observes that pursuit of the pure sciences and arts differs from vocational education because the former is an education in 'languages', i.e. it requires a thorough grasp of concepts and principles and a certain facility in using them, together with an appreciation of the internal standards of the subject and of its methods of inquiry and criteria of validation. Vocational subjects, on the other hand, resemble a study of 'literature'; that is to say, they require only a sufficient grasp of the subject matter for appreciation of substantive assertions in the texts and a modest acquaintance with the concepts and principles.* Thus university studies of a non-vocational kind may provide a 'liberal education' for they satisfy two of the three conditions given by Peters. However, the third condition is not necessarily satisfied, but depends on the breadth of the course in the university, or previous courses, and on teaching which emphasises general principles and their application. It is clear, however, that such vocational studies as medicine, education or management studies which employ knowledge from the 'pure' disciplines may by these definitions provide a liberal education given that the command of the 'languages' of the various disciplines is at a sufficiently high level to allow further learning and flexibility as knowledge develops. That is to say, there are higher vocational studies which, like applied sciences, may be a form of liberal education (115).

However, as subjects change and merge, so that almost everyone in the professions needs to be able to accept ideas from other disciplines or to understand arguments based on the 'languages' of other domains, the need for a broadly based education increases. Moreover, it may be worthwhile to consider studies of topics and ways of thinking which have wide application - for example, the study of probability with its application in the physical and human sciences, industry and design and in problems which arise in making decisions in contexts such as medicine, politics, engineering or industry. Industrialists commonly assert that some kinds of specialised education tend to foster a desire for certainty; for example, they report that among graduates in physical sciences who choose to go into industry to train as managers, some are at a loss to make decisions when not all the information is available to enable them to arrive at a uniquely best solution.

The biases which we have observed in the thinking of specialists in different fields no doubt account for the different conceptions of higher education which are advocated today. Peters (97), for example, criticises Lord Bowden's view that higher education should devote itself "like MIT and Caltec, to providing the theory necessary for solving the practical problems of the community". Perhaps it is an opposite bias which leads philosophers to wish to extend the life of the concept of 'liberal education' - a concept which originated when education in the sciences hardly existed - rather than to develop a new, more comprehensive concept appropriate to the development of wider fields of knowledge and different attitudes occasioned by the growth of the human sciences. To speak of education as initiation into 'the skill and partnership of conversation' is partly true - and may seem entirely so to the philosopher with an arts background - but it neglects those aspects of higher education which give rise to activity not only in improving men's thinking but also in modifying their environment to gain increasing control of it. Perhaps we might speak of a 'humanitarian' education or employ the combined terms 'liberal and humanitarian' where we have in mind that those who profit from higher education should not only develop their own capacities for rational thinking in a number of domains of knowledge but also learn to apply their increased understanding to benefit humanity and build a world in which this becomes increasingly possible.

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* Teachers of literature may feel that this is a poor use of the word. He would have done better to compare vocational education with an ability in translation which may proceed without a sound knowledge of language and still less requires the knowledge of human experience on which literature is based.

Chapter 2. THE 'CLASSICAL' OBJECTIVES OF UNIVERSITY TEACHING

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The use of the term 'objective' is probably less familiar to the majority of teachers in higher education, at least as a term of art, than is the expression 'the aim of education'. This has been widely used by the theorists of higher education to denote long-term objectives, the achievement of which, through some specific educational process or experience, typifies the successful product. In passing it is worthy of note that the possibility of success not being achieved by a favoured method or type of institution is a factor hardly ever taken into account by most of the theorists. Objectives may be of various kinds - short-term, intermediate, or long-term - but most thinking about educational aims has only been concerned with long-term objectives and has dealt, typically, with the 'kind of education' various institutions set out to provide. This use of terminology would appear to assume that a precise definition of the input to the student, normally stated in the form of the content alone, is a sufficient definition of education. Sometimes such statements have been accompanied by equally definite, not to say doctrinaire, pronouncements about the teaching methods to be used, as if educational virtue resided absolutely in specific pedagogical procedures of unchallengeable effectiveness, and capable of application in any circumstances.

In Western Europe the 'input' or curricular approach to thinking about educational aims must be presumed to have its origins in the assumptions which have developed as a result of the historical development of the European universities. In the course of history an immense prestige has attached to certain subjects of study such as the ancient languages or theology. This prestige goes back to the Dark Ages when a knowledge of Latin and of the authoritative texts was not only a sign of literacy but also a passport to the priesthood and to the few prestigeful occupations then open to those of humble birth. With the slow evolution of European society over the centuries education became desirable for its own sake. The Renaissance made the study of Greek more widespread, but for the generality of students this merely broadened the basis of orthodoxy, in educational terms, and added another prestigeful subject. Ultimately, at least in England, the situation was reached where knowledge of Latin and Greek, and of something of their literatures, became the aim of education and the mark of a gentleman, for the non-theological student as well as for the priest and the scholar. Thus things at first only prestigeful because of their social and professional utility came to be of themselves totems conferring prestige; from this developed the idea that certain kinds of subject matter alone had the virtue of producing the educated man, or of training the mind to deal with the tasks presented by the not very complex administrative system for which many of the students were already destined by their social origins.

The whole of higher education, except law and medicine, was concentrated in two centres, Oxford and Cambridge, until the nineteenth century. Since in the main these two universities, concerned above all with imparting instruction in the classical languages, concentrated on certain educational methods loosely called the 'tutorial method', the twin notions of classical education and of tutorial supervision came to exercise a dominant influence on thinking about higher education in England. While it is no longer true, even in Oxford or Cambridge, that the classics alone are considered essential to a complete education, the traditional ways of talking about the aims of such an education are often still used, as if nothing had changed with the passage of the centuries. The aims previously put forward as those of classical education are still to be found almost unaltered even in pronouncements about highly technical studies. In a similar way the teaching methods of the older universities are often regarded as the epitome of educational techniques, irrespective of the objectives, whether short- or long-term, which it is hoped to achieve. In this particular tradition, which at least in principle has the great virtue of taking account of the individual development of students, the stress has been on 'liberal' education, which may be defined as the general awakening and training of the intellectual faculties and the provision of a broad-based culture. Not all of this is achieved by a direct and structured educational process; the cultural elements in particular are often conveyed by a kind of environmental osmosis which unfortunately leads to certain kinds of beliefs about higher education which are not far removed from magic.

If, in this country, the Oxbridge tradition has lately been a formative influence on thinking about higher education, it has hardly been the dominant one in earlier periods of university expansion. In the middle of the last century, when this expansion was beginning, and when the idea of a philosophy of university education took root here, there were several competing views as to the aims of such education. There were also a number of causes of the upsurge of interest in the expansion of higher education: for example, a desire for more widely spread opportunity for university education among social groups which had previously been virtually excluded from it, a demand for equal right of access to university education from religious dissenters, and a call for the broadening of university studies to include the new scientific subjects. This last demand was given greater obvious urgency by the need to reaffirm the primacy of Britain as an industrial nation, and to regain the ebbing momentum of the scientific and industrial progress of countries like Germany, where the remodelled University of Berlin was leading the way in scientific research.

In England the outcome of all these various pressures, and of others besides, was the reform of the older universities, the founding of the University of London, and later of the first civic universities. The activities of the universities also underwent considerable change. The new scientific subjects, both pure and applied, became accepted, if not yet fully respectable, subjects of study, while research was recognised as a prime, and perhaps the major, duty of university teachers. This change may have been the most fundamental of all in the new university foundations of the nineteenth century, with the exception of Durham, the earliest of them. The overall result of this expansion was not to produce a number of new institutions based on the native Oxbridge model, but rather a group of new universities and colleges based more closely on continental or Scottish practice. Their chief orientation was towards the natural sciences, research was a major concern of the teachers, and teaching itself was not done by the tutorial method but mainly by lectures and seminars. However, since many of the teachers and administrators in these new institutions were trained in the two ancient universities, it is not surprising that educational thinking within them, once they had acquired an impetus of their own, tended to be strongly coloured by Oxbridge ideas and attitudes. Although this was no doubt most apparent in the more traditional, non-scientific, fields of study, similar attitudes seem to have spread rapidly into scientific and even into technological disciplines.

Two main schools of thought appear to have exercised powerful and competing influences at this formative period in the development of higher education. These are usually called the 'liberal' and the 'utilitarian' schools, although many mixtures of the two were, and continue to be, proposed, leading to much confusion of thought about the long-term objectives of the university. For such thinking has often been conducted on very different levels, even by the same person, so that arguments from one school are used to defend certain views on the purpose of the university, while arguments from the other may be brought in to support ideas on teaching. Although this may seem merely a typical case of British compromise, more often than not it is an attempt to reconcile inescapable social needs with traditionalism, or, at worst, with nostalgic sentimentalism - an attempt to recreate a lost world of the thinker's own youth (or indeed of someone else's youth, which he himself never experienced but always envied). One result of this has been a whole world of university myths in which godlike tutors dispense gallons of sherry and coffee, and undergraduates, full of intellectual promise and eager for learning, spend sunny afternoons in punts and cosy winter evenings with the Greek philosophers or in talk such as graced the salons of eighteenth century Paris or the Bloomsbury of Virginia Woolf. All of these and many more things of similar type form an academic Eldorado to which every boy or girl might have access (after suitably rigorous, but highly unscientific, selection) for a few golden years of youth. At the same time laurel-crowned scholars inhabit the ever-open libraries and laboratories, feast at the gourmets' high tables, and occasionally teach (by the tutorial method) a few hand-picked disciples, until such time as Minerva carries their spirits up on high (to an Olympus probably situated somewhere above the British Museum), and their earthly bodies are laid to rest beneath the flagstones of the chapel.

Satirical as this may seem, it is not very far removed from some of the writing and thinking about universities in this country since the end of the war. As wishful thinking it would be unobjectionable. What is tragic, however, is that a good deal of this mythology has found its way into many of the schemes which have actually come to reality and been supported by public money. Even worse, such a picture has often been the ideal of the university in the mind of the schoolboy or girl who comes to sit at the fount of wisdom in a grimy industrial town, where no punts ever grace the river as it meanders through concrete pipes under the railway station, or who goes to a university situated in a muddy field somewhere near a small town with two cinemas and a dance hall. In short, the need to provide more university places has been accepted, albeit grudgingly at times, but the thinking about what sort of places they should be, in terms of the kind of teaching to be offered, has been largely non-existent. It has been lost in the midst of large-scale exercises in landscape-gardening and town-planning, which too often assume that the British climate is comparable to that of California, and that students will have nothing to do but walk about in the open enjoying the visual experiences created for them. Teaching methods have usually been dealt with at the level of the catchword - this university will make the tutorial the basis of its work, that one the seminar, and so on. However, none has had the courage to say that it will use only the lecture, or do no teaching at all, although publicity material emanating from one university did seem to suggest that no teaching was to take place, since all the stress appeared to be placed on the educational value of chance encounters while walking about the campus.

In spite of all that has been said in the preceding paragraphs, a great deal of thinking has gone on about teaching methods, especially among those concerned with the new foundations. Much of this has been uninformed, however, in a very real sense, for there are no hard facts to base it upon, but only subjective impressions arising out of common experience of the frustrations of the present compared with the ideal worlds of the past. Furthermore, whether acknowledged or not, much of this thinking has had its real roots in the works of one or more of the thinkers who have written about universities in the past. These writers are not very difficult to identify; what may be difficult however, is to disentangle the various strands of thought which emanate from each of them in the more recent pronouncements about universities (and often, by extension, about other forms of higher education). It has already been mentioned that there were two main schools of thought which influenced this thinking. To these must be added another, which is less a school of theoretical ideas than a working philosophy of the university, namely the view of the university as an intellectual power-house and centre for the production of knowledge.

The first of the approaches we shall consider is regarded as typically British, in certain ways, and is closely identified with the University of Oxford. This is the school of thought following from the writings of John Henry Newman; inspired by the higher education context of the mid-nineteenth century, especially in Oxford, they were largely expressed in Newman's lectures, On the Scope and Nature of University Education (90) delivered at the Catholic University of Ireland. The second train of thought, which was certainly current at the time Newman was writing, as he testifies himself with some frequency, was the utilitarian view of higher education, whose exponents at that time wrote in the Edinburgh Review. This was, quite clearly, only an extension of that belief in social utility and material progress which had been so dominant a factor in the thought of the European Enlightenment in the late eighteenth century. The third major influence was that of the German universities of the nineteenth century, which subordinated all other functions to the extension of knowledge, (or 'research', as we now call it), an approach which paid handsome dividends in the nineteenth and early twentieth centuries, when German science and technology reached heights which surprised and startled the rest of the civilised world. None of these outlooks existed in isolation, at least in Britain.

One of the odder aspects of the cult of Newman, which is often found among academics diametrically opposed to all else that the Cardinal stood for, is that his ideas on education are frequently used to defend institutions and institutional practices that are the direct opposite of what he was suggesting, but perhaps this is a true measure of the universality of his ideas. His main educational objective, or, as he himself saw it, the objective of the Roman Catholic Church, in founding a university is stated in the Preface to the lectures, (90 p. xxxvi): "when the Church founds a University, she is not cherishing talent, genius, or knowledge, for their own sake, but for the sake of her children, with a view to their spiritual welfare and their religious influence and usefulness, with the object of training them to fill their respective posts in life better, and of making them more intelligent, capable, active members of society". As for research, Newman declares unequivocally in favour of a separate 'Academy' or research institute as the place in which knowledge is advanced. "To discover and to teach", he says, "are distinct functions; they are also distinct gifts, and are not commonly found in the same person". (90 p. xxxvii). It is not our purpose here to examine the whole of Newman's conception of the university, still less to subject it to detailed criticism. However, at this stage it may be well to remember that many of Newman's views and ideas, often indeed his very words, have passed into general discussion about universities in this country (and hardly at all in non-English speaking countries), but that they are now commonly used for purposes which may well be very far from what Newman himself meant. Certain of those ideas and phrases will be remarked upon later, and it will be seen that Newman, if he was not the real progenitor of most current ideas about the purpose of the university, at least provided much of the terminology in which these ideas tend to be expressed.

For our purposes here, however, it is necessary to stress what was for Newman undoubtedly one of the main functions of any university, whether Catholic, Protestant or secular, namely education in the liberal arts or, as he calls it, 'liberal knowledge'. This, as becomes manifestly clear in Newman's discourses, is the kind of education proposed by the reformed colleges of Oxford. It was liberal education which consciously aimed at producing the 'Gentleman' (Newman does not hesitate to use the word), not through external polish, deportment, and manners, but rather through the training of the intellect. This idea is the basic educational concept which informs two lectures, "Liberal Knowledge its own end" and "Liberal Knowledge viewed in relation to learning". It is undoubtedly Newman who is the source of the very widespread view that a major aim of university education is to develop the individual intellect as broadly as possible with the 'liberal arts' as the core subjects of this broadening process. Basically, of course, the idea was not new, nor was it Newman's invention. It was merely the projection of the medieval system, by which the boy, who had somewhere studied Latin, went to the university and there studied the elements of knowledge, the trivium and quadrivium before going on to undertake the studies of the professional schools in theology, or in the canon or civil law. Whether or not we accept Newman's views as being applicable to present-day universities and other institutions of higher learning, it is difficult to deny that most university teachers appear to act on the assumption that training the intellect, irrespective of any professional advantages which may accrue, is the real aim of an institution of higher education, as distinct from one which merely provides professional training. Once again, whether or not this is a tenable position in a mid-twentieth century context is not our real concern here. Since the purpose of this series is to discuss teaching in universities, and since many university teachers share Newman's educational objectives in a broad sense, it may be instructive to examine some of his views as to how these objectives are to be achieved.

A large part of the present series will be concerned with matters which, at first sight, do not have any apparent connection with Newman, nor even perhaps with the ways in which many teachers outside the behavioural sciences habitually view the teaching function. The concept of behavioural change often proves a difficult, if not a positively explosive one, when first introduced in discussion with groups of colleagues; indeed, in the writers' experience, it has been interjected in such discussions that the teacher is not concerned with producing "changes in the student". A little thought will soon make it clear that teaching is only successful when it makes the student in some way different from the person he was before, even if merely to the extent of knowing more facts, however futile these may be. If our aim is to develop the intellect to its fullest extent, then this must bring about a considerable change in the student, since by definition he will be different from one who has not had his intellect so developed. This is quite apart from any side-effects such as changes in his personality, an increase in confidence, an increase or decrease in religious or political faiths, which may have happened as a result of the basic change. At the very beginning of his book, in the Preface (90 p. xxxviii), Newman shows that he is well aware of the role education plays in changing the student; he does not shrink from explicit recognition of this point - "whether or no a Catholic University should put before it, as its great object, to make its students 'gentlemen', still to make them something or other is its great object". He even goes on to stress that this function of bringing about a change is the "great object", rather than "simply to protect the interests and advance the dominion of science".

A little further on Newman states his objective, or rather his main educational, as distinct from propagandist, objective (although these sometimes merge), as the "culture of the intellect", which he clearly sees as being the primary aim of liberal education. (90 p. xl). "Certainly", he says "a liberal education does manifest itself in a courtesy, propriety, and polish of word and action, which is beautiful in itself, and acceptable to others; but it does much more. It brings the mind into form, - for the mind is like the body." (90 p. xl - xli). The idea is worthy of note, if only for the fact that the very same notion is taken up again by another philosopher of university education, Ortega y Gasset, in his The Mission of the University (93), although he does not acknowledge a debt to Newman, as far as can be seen. What is important in the present context, however, is that Newman makes an analogy between body and mind which is constantly apparent as an informing principle of his attitude towards education. Many who imply that education is a mysterious process which can only be conceived in quasi-mystical terms, and in which all the factors of importance are intangible and unmeasurable, seem to be invoking Newman's ideas. Newman, himself did not exhibit this attitude. Indeed his view appears to accommodate itself well with the approaches of the behavioural sciences, even if, on occasion, he accepts conventional ideas of his time somewhat uncritically. It is also obvious, at least in his statements of overall objectives, that Newman makes a clear distinction between mental and spiritual qualities; he sees nothing untoward in adopting an attitude to the educational process which is compatible with a materialistic determination (in terms of objectives and methods), because, for him, the world of the spirit is something quite different, something that the mind can be led towards by appropriate training. It may be useful to note here that although Newman's lectures are quite openly propagandist in terms of religious intent, they are not basically concerned with ultimate questions of metaphysics or theology; these he takes for granted.

Newman makes it clear that he is concerned simply with "the aims and principles of education". (90. p. xliii). This is a very common approach among those who undertake to write on university education, and is certainly a far easier one than entering into more precise details of the way in which ideals are to be achieved with any certainty in teaching. Newman, however, cannot be accused of refusal to face the hard facts of the teacher-student confrontation altogether, although he declines to consider it as his true purpose in these lectures. Like most other theorists in the field, he states the subject matter which he judges appropriate to the educational objectives he has in mind and develops in some detail his reasons for including various kinds of subjects in the curriculum. What he describes is not in the least novel, nor, one assumes, are the reasons he gives very different from those any other fairly conventional educator would have given around 1850; but Newman does not baulk at the necessity for stating clearly, and in terms which might in the language of modern thought be called 'operational' or 'behavioural', just what effects he hopes liberal education will produce.

In the lecture, "Liberal Knowledge its own End", Newman speaks of knowledge and education in a way that clearly demonstrates that he does not regard them as generalized qualities which are either self-evident or defy definition, but rather as processes taking place within specified contexts and defined by enumeration of their effects. Hence: "when I speak of Knowledge, I mean something intellectual, something which grasps what is perceived through the senses; something which takes a view of things; which sees more than the senses convey; which reasons upon what it sees, and while it sees; which invests it with an idea" (90. p. 104). A little further on 'education' is given a meaning which once more clearly demonstrates the 'operational' nature of Newman's approach, whether or not we agree with the second part of his statement: "Education ..... implies an action upon our mental nature, and the formation of a character". (90. p. 105). Similarly, a little earlier, he had spoken of a university's "treatment of its students" (our emphasis). (90. p. 93), when talking of the habits of mind which should form in them. On the whole it would appear that such parts of Newman's thought as have passed into university theory are not those just quoted, but rather the more appealingly vague notions which are, in truth, equally plentiful in this text, such as: "Liberal education makes not the Christian, not the Catholic, but the gentleman" (90. p. 112), or "Liberal Education, viewed in itself, is simply the cultivation of the intellect as such, and its object is nothing more or less than intellectual excellence."

(90. p. 113). Most academics at some time have quoted or paraphrased these words of Newman, usually without further exegesis, but very few seem to be aware that he was also conscious of the more clearly definable "action upon our mental nature".

Towards the end of this lecture Newman restates the aims of Liberal Education in terms which tend in the same direction as those an educational psychologist would use today, although, of course, he is rather less rigorous. He moves at least one step away from broad generalisation, nearer to a set of statements of second order objectives on which an educational programme might be built, when he says: "To open the mind, to correct it, to refine it, to enable it to know, and to digest, master, rule, and use its knowledge, to give it power over its own faculties, application, flexibility, method, critical exactness, sagacity, resource, address, eloquent expression. . . ." (90 p. 114). Each of these is an objective which could be expressed in terms of expected performance in a particular section of a discipline, and made to form the basis of a programmed course. Newman's illustration of how a tutor could bring his pupil to appreciate the manner of writing good latinity is close to the methods of the programmed approach. (91. p. 362 et seq). Indeed it may be taken as an example of the way in which good teachers will always evolve forms of programming on their own initiative.

It is in Newman's fifth Discourse, "Liberal Knowledge viewed in relation to Learning" (90. p. 116 et seq) that he has most to say about the detailed processes of university education. In certain ways this discourse is highly illuminating since it could be interpreted as an essay on the relationship between the quantity of knowledge communicated to the student and the quality of the intellectual training which he obtains, although the true meaning of its title appears to be the manner in which liberal education is related to the actual acquisition of both the quality and quantity of knowledge. Newman, not unexpectedly, is opposed to a mere 'cramming' with knowledge, just as he also appears to be opposed to certain forms of scholarship and erudition: "there are authors who are as pointless as they are inexhaustible in their literary resources. They measure knowledge by bulk, as it lies in the rude block, without symmetry, without design." (90. p. 132). His intention is plain here: the purpose of university education is to train the intellect, not to stock it with undigested knowledge; neither is its purpose to produce scholars, as some still claim: "Nor am I banishing, far from it, the possessors of deep and multifarious learning from my ideal University; they adorn it in the eyes of men; I do but say that they constitute no type of the results at which it aims; that it is no great gain to the intellect to have enlarged the memory at the expense of faculties which are indisputedly higher." (90. p. 134). Education, as Newman makes quite clear is "the preparation for knowledge, and it is the imparting of knowledge in proportion to that preparation." (90. p. 137).

At this point it is evident that Newman's concept of the university owes much to his own intellectual development at Oxford; he enunciates views on university education which have come to be identified with the older British foundations and to be the ideal of very many university teachers. Essentially these are, firstly, what one may call individual attention - "A University is, according to the usual designation, an Alma Mater, knowing her children one by one, not a foundry, or a mint, or a treadmill" (90. p. 137) and secondly, the view that mutual education takes place, as if by accident, through the interaction of members of a peer group. The last idea is stated by Newman in a way which makes it clear that he is reacting against certain conceptions of a university, especially the federal examining university such as London or the Royal University of Ireland: "I protest to you, gentlemen, that if I had to choose between a so-called University which dispensed with residence and tutorial superintendence, and gave its degrees to any person who passed an examination in a wide range of subjects, and a University which had no professors or examinations at all, but merely brought a number of young men together for three or four years, and then sent them away as the University of Oxford is said to have done sixty years since (written in 1852), ... if I must determine which of the two courses was the more successful in training, moulding, enlarging the mind, which sent out men the more fitted for their secular duties, which produced better public men, men of the world, men whose names would descend to posterity, I have no hesitation in giving the preference to that University which did nothing, over that which exacted of its members an acquaintance with every science under the sun." (90. pp. 137-138).

Unlike many who have since expressed similar ideas, Newman develops what he means by this apparent paradox of an educational institution which does no more than bring its students together. What Newman in effect does is to outline the process which had created the tradition of the older universities. "When a multitude of young persons, keen, open-hearted, sympathetic, and observant, as young persons are, come together and freely mix with each other, they are sure to learn from one another, even if there be no one to teach them; the conversation of all is a series of lectures to each, and they gain for themselves new ideas and views, fresh matter of thought and distinct principles for judging and acting, day by day .... It is seeing the world on a small field with little trouble; for the pupils or students come from very different places, and with widely different notions, and there is much to generalise, much to adjust, much to eliminate, there are inter-relations to be defined, and conventional rules to be established, in the process, by which the whole assemblage is moulded together, and gains one tone and one character." (90. pp. 138-9). He goes on to say that, since those who eventually occupy positions of authority in such institutions will themselves have experienced this process, which in any case is self-perpetuating, an equally self-perpetuating tradition will arise in the course of time. This Newman sees as a "living Teaching", a term which he does not define further, but which presumably means a form of teaching which is living because it is inherent in the environment itself. (90. p. 139).

Whatever one may think about the universal validity of Newman's generalisation from his Oxford experience, which he is here seeking to apply in the vastly different context of Catholic Ireland, it is useful to notice that he still views this in what we have called an 'operational' light; and one in which the educational experience is seen as a pattern of behavioural change resulting from the contrived environment created by bringing together young people from diverse backgrounds. Furthermore, and this may seem surprising to many in view of Newman's obvious and heavily committed position on religious and moral issues, he makes clear that he is attempting to see this matter in an objective way, looking only at the educational process. "Let it be clearly understood," he says, "I repeat it, that I am not taking into account moral or religious considerations." (90. p.139). Earlier, indeed, he has gone so far as to admit that the system he is extolling had "miserable deformities on the side of morals, with a hollow profession of Christianity and a heathen code of ethics." (90. p. 138), but he nevertheless discerned its educational value. At the risk of over-generalisation, it may be observed that many of those who, since Newman, have sung the praises of the system he is here describing, have tended to attribute to it, explicitly or implicitly, the cultivation of these very virtues which Newman denies it. Later thinking on this matter has been, on the whole, much less rigorous. Above all, he saw processes taking place in a definite physical and intellectual environment, and tried, as far as possible in view of contemporary concepts, to define them in terms of behavioural change. However, the rigour of his thinking did not extend to a consideration of the differences in environment and culture between the society for which he was trying to legislate and that from which he drew his examples.

In several places in his "Discourses" Newman makes it clear that he is reacting against a certain view of education which had been inherent in the thought of John Locke in the seventeenth century, as Newman himself points out in the VIIth Discourse. This was put forward again with vigour in the Edinburgh Review during the controversy about the reform of the University of Oxford. The contrary philosophy of university education, the Utilitarian view, was at that time proposed by Professor Playfair, Lord Jeffery and the Reverend Sydney Smith, three "giants of the North" as Newman ironically calls them. He also points out that it was not an idea which had originated with them. The Utilitarian view of university education needs little explanation; it consists essentially in the idea that a university should concern itself with studying and teaching those things which are useful to society as a whole. Newman quotes the writers in the Review as saying: "What other measure is there of dignity in intellectual labour but usefulness?" (90. p. 154). Adroitly, he turns this into an argument in favour of liberal education; since the aim of liberal education is the full development of the intellect of the individual; and as this enables him to play his part in society better, it follows that liberal education is ipso facto of the greatest utility to both the individual and society. On the whole Newman's view seems to have held sway up to the present day in all discussions about university education, but it is the utilitarian one which has been used as a basis for action, both by successive governments and by academic planners, especially those in charge of the distribution of funds.

There seems to be a strong tendency to identify a utilitarian approach to university education with a bias towards the natural sciences, although there is no reason why this need be so. Although science and technology present obvious examples of fields in which directly useful disciplines can be studied, there is no reason why many aspects of the social sciences, and indeed some of the usual 'arts' subjects such as languages, should not be studied with a purely utilitarian objective in mind. The most persistent idea, however, is that of a necessary connection between natural science and utility, and this has led to the linking of the Utilitarians with those who were interested in upholding the claims of science as a subject for study. However, these thinkers, of whom Thomas Huxley (59) was the most prominent, did not wish to see Liberal Studies ousted, nor to see education used merely as a means of producing people to fill specific functions. For Huxley, an education was not 'liberal' unless it contained a study of science as well as arts. In so far as the natural sciences led to a better understanding of nature, they were essential. Established authority in intellectual matters, either religious or scientific, had no hold over his mind; indeed his life was in part a quest for intellectual freedom and truth in the teeth of traditional authority. This was not a purely personal objective, but one which informed his whole thinking on education, and it probably gave him greater practical effectiveness.

Huxley considered University education a direct continuation of primary and secondary education, on both of which he had a great deal of influence. For him, every schoolboy starting at a primary school carried in his satchel a cap and gown. He was strongly opposed to a system whereby state education would produce more efficient factory operatives, while private education would send a chosen few to the university. His views were clearly informed by several factors such as egalitarianism, love of truth, opposition to imposed authority in intellectual matters, devotion to scientific method, and a conviction that the liberal arts had great value in the development of the individual. His chief educational objectives were to develop observation and reasoning; to seek the truth, and in so doing to question authority. He defined the educated man as he "who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of Nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of Nature or of Art, to hate all vileness, and to respect others as himself. Such an one, and no other, I conceive, has had a liberal education; for he is, as completely as a man can be, in harmony with nature."

Such a view includes a great part of Newman's ideal, although it is clearly based on different personal beliefs. It adopts an essentially mechanistic view of the mind and the body, and, although it refers to spiritual and moral values, these are not based on any specific metaphysical beliefs. Here again, although perhaps to a lesser extent than in Newman's Discourses, the aims are formulated in what we have called an 'operational' manner, rather than in terms of what the liberally educated man should know, or what he should have been taught; they are expressed in terms of the result, namely what the body and the mind should be able to perform, even if these objectives are stated in very broad and general terms. These definitions differ from later ones - it would be invidious to quote examples - in that Huxley is not defining education in terms of the courses undertaken or examinations passed but rather in terms of what a 'liberally educated' man should be like at the end of it. Even so, Huxley, unlike Newman, does not give a detailed analysis of the various kinds of performance expected. The important point is that both writers are at pains to define what they mean by 'education' and do so in terms of performance; they are not content with a simple description or catalogue of mental qualities, nor do they give details of suitable curriculum, although, obviously, these would have to follow at some point if a general set of objectives were to be translated into action.

So, like Newman, Huxley was not concerned with the details of pedagogical method; however, he did have certain principles of action which must themselves have led to fairly firm conclusions about some aspects of teaching and learning. His chief concern was science, although he also gave a high place to such things as English Literature, History and Political Economy; only science had the virtue of teaching a method of thought and action. In other words he was concerned with teaching scientific method rather than scientific facts, and for this purpose he held that teaching should come from dealing with things and not books; science teaching should follow a practical, rather than theoretical approach. An essential function of education was to make a student discover for himself as well as to think for himself. It was not enough to hypothesise and debate, a student had to be able to test his hypotheses by experiment and observation, and to reject them dispassionately if they did not fit the observations. This was the training that science gave the intellect; it had to be carried out in the laboratory and field, not in the lecture hall. Huxley was, however, concerned with wider aspects of teaching and was not content with simply stating his main objective; he held that all possible aids to teaching should be used in universities, and that their teachers should be taught both to teach and to examine.

We discover a major difference between Huxley and Newman in their views about the fundamental purpose of the university. The Catholic thinker was not convinced of the importance of research, either as a fundamental of the university or as an important function of its teachers, and saw no necessary connection between it and teaching. Huxley held opposing views. For him research was more important than teaching, the research worker was better for doing a little teaching and the teacher better for doing research; he held also that the student was better for being brought face to face with discovery and the quest for new knowledge. The difference is probably explained in terms of the different basic assumptions of the two men. Huxley was a natural scientist, keeping abreast of the great discoveries of his age, such as those of Darwin, and he clearly had a perspective of the infinitely expanding nature of science, unfettered by metaphysical restraints. Newman, on the other hand, held fast to the view that Theology was the key to the ultimate truth, with which other kinds of truth must harmonise. Thus the human intellect should be trained for purposes which were ultimately metaphysical, albeit through profane knowledge, while acquisition of new truths must remain subordinate to this purpose. In spite of his conviction about the importance of research Huxley, like Newman, did not regard the mere acquisition of knowledge as a primary aim of education. The student brought into contact with the quest for new knowledge would be fired with the idea and with the enthusiasm for truth that was more valuable than much learning.

Huxley can be identified with the Utilitarians in so far as their views coincided on the role of scientific and technical efficiency as the means of ensuring the future economic progress of the country. For this reason he tried to turn university education more firmly towards these fields of study, which no doubt also led him to adopt the view that no subject was unfit for university study, provided that it was dealt with in depth and with integrity. His definition of a university was, indeed, such that it could apply to a much broader-based institution than that thought of by Newman. "Any corporation of men associated together for the purpose of teaching all forms of precise and accurate knowledge, the object of which was to give the highest intellectual culture that could be given, and to encourage the pursuit of knowledge in perfect freedom and without let or hindrance from any subsidiary consideration", was, said Huxley, "performing the function of a university, and was one whatever be its name".

Since Huxley was one of the champions of egalitarianism he firmly held the view that everyone regardless of religion or class background, should have a right to education at all levels, if able to profit by it. He was apparently more aware than Newman of practical requirements such as entrance qualifications; he thought that these should not be too rigid, perhaps because of his views on equality of access. In various other ways his ideas foreshadow the development of universities in the twentieth century rather than in his own. This shows the forward-looking approach of his thinking, even though some of the things he then foresaw are today frequently the targets of criticism. In general he may be said to have been in favour of specialisation - he thought that students should not be expected to follow many courses concurrently, as this fragmented their attention, and resulted in useless cramming for examinations - "It is important not so much to know a thing as to have known it and known it thoroughly". "There should not be too many subjects in the curriculum ...... the aim should be the attainment of a thorough knowledge of each". Many of his ideas, in fact, have been applied in American universities, although no direct debt to Huxley has been acknowledged. Each part of the course, he thought, should be examined before passing on to the next, instead of examining all parts at one time; this can can be seen as a clear move in the direction of the 'credits' system. He also thought in terms of separate institutions concerned with General Education (Arts), Professional Education and Research, a system not unlike the Liberal Arts College, Graduate School, and Research Institutes found in many transatlantic universities. As a final point, and one on which he half agrees with Newman, Huxley wished to see a system in which the professorial (or ex cathedra) lecture system was integrated with a tutorial approach to teaching.

In terms of their ultimate objectives Huxley and Newman are probably less far apart than has sometimes been thought; where they differ considerably is in the manner of achieving these objectives and the way they assign importance to teaching and research in the overall role of the university. Huxley was not alone in thinking that science has an important part to play in education and it may be said that this view prevailed at the founding of many British 'Redbrick' universities (Huxley was present in person at the inauguration of some of them). The writings of Herbert Spencer were influential in the same direction, especially his Education: Intellectual, Moral and Physical (107). Spencer produces his own taxonomy of knowledge, in which he sets up specific categories - knowledge which prepares us for self-preparation, knowledge which prepares us for leisure - a clear enough set of first-order objectives. He then makes it perfectly plain that the study of natural science is to be pre-eminent: "Whether for intellectual, moral, or religious study of grammar and lexicon"; or, in similar vein - "What knowledge is of most worth? - science; and as knowledge grows, and education develops, science will eventually reign supreme". This emphasis on science, however, could be taken as a sign of the insularity of the English at that time, for universities elsewhere already believed in the pre-eminence of scientific method and in research as the primary aim of a university. This was true to some extent of the Scottish universities, but was much more the case in Germany, where several flourishing institutions, notably the University of Berlin, were already the envy of the civilised world. The influence of these universities was apparent, both in the foundation of the new English universities, and in the form that these new institutions took. Moreover, the scientific outlook was not limited to the purely scientific departments. Firmly based on the professorial system, the same outlook had spread over the whole field of knowledge, finding one of its most striking manifestations in the 'Arts' field in the work of the great German philologists, and producing an approach to such studies which Newman, although he does not expressly mention it, must have been reacting against.

It seems possible that from an amalgam of the various ideas so far discussed evolved the general objectives and philosophy on which the second generation of English universities was founded. On the whole the example of Berlin and the ideas of Huxley and his followers prevailed, judging from the pre-eminence accorded to science, and the key position given to research. This stress on science and research, linked as it is to advancement, establishes a firm professional hierarchy in which progress is closely tied to the output of new knowledge. Consequently the teaching function is reduced to a necessary but subordinate place, very often performed in an amateur manner quite in contrast to the professional approach to research. However, Newman has remained an inspiration for academic thinkers, no doubt partly because Oxford, the source of his ideas, continued to be the most prestigeful of all universities, the one which many academics wished, and still wish to emulate. Indeed the older universities, in the main, have preserved their eminence as teaching universities, at the same time becoming highly respected research centres. However, so far they have done little to apply scientific principles to the investigation of the teaching methods they employ, preferring merely to rely on the prestige conferred by time. This prestige is not necessarily due to any proven superiority of the methods used, but rather to the fact that other institutions simply cannot afford to provide such methods on the same scale.

These, then, were the views of the great nineteenth century thinkers on university education. Before they can be brought into perspective the social background under which they developed must be examined. At the beginning of this era, the established church held great power in the traditional universities. Science and religion had come to a comfortable compromise, in which the former demonstrated how wondrous was the study of the latter. The two great universities of England had degenerated into what was later to be called by the Rector of Lincoln College, "boarding schools in which the elements of the learned languages are taught to youths". Education at this time was an adornment for those rich enough not to need to work, and therefore, the more useless their study from a practical or professional point of view, the more it emphasized how wealthy they were. Culture meant an appreciation of art, liberal education meant knowledge of the classics, and intellectual development meant primarily a study of the great writers of antiquity. The concept that a man could advance knowledge by his own experiment, rather than by thought alone, had yet to develop.

Against this backcloth of a predominantly rural scene in which many laboured without formal education, while many of those who studied did not need to turn their knowledge to any account, appeared the scientist and the industrialist. The former, as exemplified by Darwin, shattered the warm coalition between church and science, and the latter became aware of the need to educate the masses in order that England could answer the challenge of the industrial age. Compulsory education and the reform of the universities followed. Both Newman and Huxley were determined that the universities should be restored to their rightful role as intellectual training grounds. However, they disagreed profoundly on the manner in which this purely intellectual development might be produced. This disagreement could be due to differences in background of the two men, although oddly enough they both went to the same school. However, whereas Newman, being an eminently successful son of a wealthy father, enjoyed a traditional public school classical education through Oxford, Huxley was forced to leave school at the age of ten because of his father's economic failure. He was subsequently self-educated. In contrast to Newman's sheltered formative years teaching at Oxford among the limited stimulus of his colleagues, Huxley worked first in the East End of London, then at medical school and finally, after qualifying, joined the Navy. Newman had his traditional teachers to look up to and his classical authorities to refer to, but Huxley worked independently and defied even the Admiralty. A prolific research worker, he was Fellow of the Royal Society at twenty-five, and later its President. A practical man, his advice and help were sought at cabinet level. Newman, however, reached the lofty height of influence in other, not less influential, spheres. It is little wonder that Newman looked to heaven and to the past for inspiration, and urged his pupils to study the thoughts of the old philosophers for their intellectual betterment, whereas Huxley urged them to stand on their own feet and look forward to the next century of discovery, and to sharpen their wits on scientific method. Inevitably, the tradition of Newman passed over into an era where tradition is still valued for its own sake, but it was also inevitable that this would be tempered by the clear sight of a man like Huxley. By reason of his great power and deeds he could speak with equal authority at Oxford, Baltimore or a working man's club and so left his mark on the minds of his fellow-countrymen.

Following the heyday of Newman and Huxley, thinking about university education was not very active for several decades after the turn of the century. However, just before and just after the Second World War two new treatises on university education were produced, the first in Spain by Ortega y Gasset, and the other in Germany by Karl Jaspers. Both these works, more than any other of the present century, have been quoted in recent debates on the philosophy of university education although neither of them does much more than restate fundamental positions originating from Newman and Huxley, or derived from existing continental practice. However, very clearly stated in Ortega's The Mission of the University (93) is a point of view precisely opposite that of Huxley and most members of the academic profession about research and teaching going hand in hand and teachers having to take part in research: "Knowledge and research have their own structure, which is not applicable to that other activity proposing to impart knowledge. The principle of pedagogy is entirely different from that on which culture and science are built." Not only is Ortega prepared to state this unequivocally, but he also provides a rationale for university teaching, or presumably any other kind, based on the view that education has "with peculiar blindness, centred about knowledge and the teacher", rather than about the learner. He cites Rousseau, Pestalozzi, Froebel and the German Idealists to support his view that all education should be centred on the characteristics of the learner; this he says, "alone can guide us in our effort to make something organic of education."

In a manner reminiscent of Herbert Spencer he holds that "man is occupied and preoccupied with education and for a reason which is simple, bald, and devoid of glamour: in order to live with assurance and freedom and efficiency, it is necessary to know an enormous number of things"; to this he adds his characteristic argument, "and the child or youth has an extremely limited capacity for learning." This favourite, though frequently overlooked, point is reinforced later: "Scarcity of the capacity to learn is the cardinal principle of education. It is necessary to provide for teaching precisely in proportion as the learner is unable to learn." Moreover, says Ortega, knowledge is growing so fast that we must operate on the principle of economy in education; our science of teaching must be based on the simple idea that the student cannot learn all that we should like him to know. This puts the onus on the teacher to select material and to match it with his knowledge of the learning capacity of the student. Although this rule has always been in operation, he says, wherever there has been teaching activity, it had never been set up as a principle "perhaps because at first sight it is not dramatic - it does not talk of imposing transcendentals." Developing his argument Ortega continues "The University of today, outside Spain even more than within, is a tropical underbrush of subject matters...... There is no remedy but to rise up against this turgid undergrowth and use the principle of economy like a hatchet. First of all a thorough pruning." He then proceeds to extend his principle from the teaching situation to the organisation of the university itself, which must "be based upon the student, and not upon the professor or upon knowledge"; it must be the projection of the student to the scale of the institution. And the student's two 'dimensions' are, first, what he is - a being of limited learning capacity - and second, what he needs to know in order to live his life. The principle of the student university is not new, as Ortega himself is quick to point out - it is a return to the type of organisation existing originally at Bologna in the Middle Ages - but he gives it a new twist by linking it with his pedagogical principle that teaching must be geared to learning capacity. This principle is certainly found in many modern paradigms of the learning situation, as well as in Rousseau, and other earlier thinkers who based their arguments on common sense rather than experimental evidence.

The other writer of whom we have spoken is Karl Jaspers (64). To him the university is "an institution uniting those professionally dedicated to the quest and transmission of truth in scientific terms." Later he states unequivocally that "research is the foremost concern of the university, ... the university's second concern is teaching; because truth must also be transmitted." Jasper's approach to the whole subject of teaching is made up for the most part of a series of seemingly authoritative statements relying on no other evidence than traditional use. He is not concerned with the majority of students: "University education addresses itself not to the few geniuses or to the mediocre average, but to that minority who while capable of growth and of initiative, nevertheless stand in need of instruction."

Some of present day talk and discussion about university teaching tends to sound rather as if it were based on the writings of Karl Jaspers, so full is it of crude assertions about method and untested assumptions about students (in the Anglo-Saxon context these assumptions seem much less flattering to the students than do the more idealistic ones frequently made by Jaspers). Nevertheless there is still much current ideology which has its roots in Newman and Huxley. While Huxley and Jaspers share the research based conception of the university - they almost certainly derived it from the common source of nineteenth century Germany - Huxley has probably played a large part in forming the purely scientific frame of mind which is hostile to professional training in British universities. Newman also contributed to this attitude, but he added the idea of the 'gentleman', an idea always lurking somewhere in the British academic mind. Also he undoubtedly helped to strengthen the idealised view that Oxford practices in teaching should be the ultimate aim. It is to Newman and Ortega y Gasset that people have turned since the war, to find views and ideas for the debate on liberal education. This has resulted in many different theories and even in actual educational schemes, so that these thinkers have had considerable influence on the academic planning of certain of the newer universities. It is surprising, and also rather regrettable, that they have been raided for their general ideas, their views on the ethos of a university and of its objectives in the broadest sense, but not for their way of stating more limited objectives, those of the teaching process itself. Newman, Huxley and Ortega y Gasset seem to have discovered the keystone on which the whole edifice must be built - the fact that education must, by definition, be seeking to produce a behavioural change in the learner. Ortega y Gasset goes even further in that he seeks to build his whole university around the learner and his limitations. Although none of them was an expert, in the modern sense, on pedagogical method, they all saw the need to define their objectives in a manner which is not too far removed from that of an educational psychologist of today.

Chapter 3. A PSYCHOLOGIST'S APPROACH TO DEFINING OBJECTIVES

Ruth M. Beard

1. The need for clearly defined aims in teaching

In the teaching of any subject clarification of objectives is essential for two main reasons: firstly, in the majority of subjects there are many possible objectives so that, if time and resources are not to be wasted, a decision must be made as to which should be pursued; secondly, it is impossible to verify whether teaching and learning have been effective if it is uncertain what either is supposed to achieve. In general, teachers are aware of certain ultimate aims of their courses partly because they have fairly clear views as to what constitutes a satisfactory degree of mastery of the subject matter, and partly because of social demands on those who qualify to gain degrees in their subjects. It is not usually the function of the psychologist to aid them in determining these long term goals - for example, the professional skills and attitudes required by the doctor or statistician - but once they have been decided by experts in the field on professional, social and philosophical grounds, the psychologist can suggest intermediate aims to maintain the interest of students, or indicate learning programmes and methods of evaluation to ensure that they are achieved efficiently.

Inadequate definition of intermediate objectives has fairly easily recognised consequences: among students it results in loss of motivation which reveals itself by lack of interest, putting off tasks to the last moment, questioning the value of the course as a whole, or even by forthright criticism; whereas in the case of their teachers it is seen in frustration from the unco-operative attitude of students and in the belief that students desire the rewards which a degree will bring them without undertaking the work. As an instance, a teacher of clinical medicine mentioned to his students in the introductory course that they should observe 'patient care' and that it would be examined in finals - three years later; he was surprised to find that they made little attempt to observe it until shortly before the final examination. A psychologist would certainly suggest some intermediate objectives here. To mention only a few possibilities: he might use a questionnaire directing students to particular kinds of observations by means of carefully framed questions with space for additional observations; or students could be asked to record their observations during a period of a few weeks prior to a general discussion or, again, individuals in the group might be asked to observe particular aspects of patient care with the object of reporting them to the whole group. For several reasons the first of these alternatives would be likely to prove most efficient in the long run: firstly, the teacher could ensure that everything important was covered; secondly, an active response increases interest and makes memorization easier; and thirdly, if correct answers were made available, each student would have an accurate record for revision.

Statement of aims without relating them to teaching methods or arranging for their evaluation is almost equally inadequate. Miller (87) reported of the

Medical Schools in Illinois in the 40's that an aim high on the list in the prospectus was development of critical thinking, but teachers observed in seminars talked for more than 75 per cent of the time and questions were not encouraged. When results in tests of critical thinking were compared with grades given in the medical department it appeared that the 25 students who thought most critically had more faulty grades than the least critical 25. Similarly in a study in the United States of a large number of colleges, Jacob (61) found that although teachers believed that they influenced students' attitudes there was no evidence of changes in students' values, beliefs or personalities. But in an experiment where new methods of teaching were set up to inculcate an interest in comprehensive medical care the experimental group showed a superior attitude in this respect to the control group (47).

Where no clear cut aims are previously agreed, inquiry suggests that in any one department the aims and teaching methods of the staff may differ widely. Studies by Walton and Drewery (118) showed the existence of no less than four types of aim among twenty-one teachers of psychiatry. Although all the teachers aimed to provide systematic information, this was the exclusive goal of three of them; six others, in addition, taught with a psycho-dynamic orientation; seven shared these goals but also aimed to teach behavioural science; while the remaining five included as a fourth aim to modify the behaviour of students. On examination of their specialities it proved that hospital staff lecturers tended to have aims of the first two kinds while academic lecturers favoured the last two, the difference between them in this respect being significant. A further significant difference was found between lecturers with a combined subject orientation (usually academic lecturers) who had scientific and behaviour modifying goals, whereas those with a unidimensional subject orientation had informational goals only. Thus although there may be latitude for variety in aim and method among staff members in teaching different topics, and it is conceivable that their varied approaches may be beneficial to students by providing for different interests, it is nevertheless essential to know what biases exist if a well directed teaching programme is to be devised.

In addition to differences between staff, those between students must also be considered if objectives are to be defined which will make teaching fully effective. The students' levels of development on entry to a course must be taken into account together with their different abilities and approaches to study. The investigation of Jahoda and Thomas (62) shows that students differ in their aims in learning and that they employ a variety of techniques in studying which may be more or less effective. The suggestion of the authors, that staff should spend time early in the course on individual tutoring, encouraging students to examine their learning processes in order to save time later and to increase the students' range of learning, points to a new way of achieving effective learning which has hardly been looked at even in schools where teachers are much concerned to make their courses effective.

A further factor which must be taken into account in outlining objectives is the changing situation with regard both to subject matter and to the introduction of new techniques of teaching. The rapidity with which most scientific subjects develop and change suggests the importance of stressing principles and how to apply them, rather than concentrating on acquisition of information. New techniques allow greater efficiency in various aspects of teaching - large numbers may be simultaneously taught by television, or individuals can repeat work privately using tapes, or tapes combined with visual aids. Demonstrations formerly visible to a few individuals can now be shown to hundreds while a difficult topic which used to require the aid of a teacher may be programmed into sufficiently small stages for the least able student to tackle it alone. Investigations by psychologists show the advantages of all these techniques in various circumstances. Since both developments in subject matter and in teaching techniques are likely to continue with increasing momentum, frequent review of aims in teaching will almost certainly become necessary.

So soon as goals such as memorisation of information, grasp of principles, mastery of skills, acquisition of a scientific attitude, independence, and so on, have been decided on, numerous questions are raised with regard to teaching methods and evaluation. Are different teaching methods required to achieve different aims? For example, can critical thinking be encouraged as readily in lectures as in group discussions? How does a student learn to work independently - by reading, use of programmed books, preparation of a dissertation, by solving problems or by some other means? And, where the aim is acquisition of information how can it be achieved most efficiently, ensuring maximum retention of the facts in the minimum time? Further, by what means should the success of teaching methods be evaluated? And how are we to maintain the students' interest or even to increase their output of productive work?

2. The schools of psychology

It is important to realise that the main families of psychologists differ essentially in the educational aims they set up as well as in the means they use to achieve them. The schools derive from two different experimental approaches in the study of problem solving - that of the Gestalt School and of Thorndike's 'Connectionism'. In the 1920's the Gestalt psychologists experimented with apes, allowing them experience of playing with sticks or boxes, prior to setting them problems by putting a 'reward' such as a banana out of reach. Apes who had had appropriate play experiences were at first puzzled but then suddenly realised the possibilities of their toys to reach the inaccessible fruit, even fitting sticks together or piling boxes into towers. Thorndike, on the other hand, experimented by putting cats in boxes which could be opened by pressing a lever. The random movements of the cat eventually led to its chance escape, but on successive occasions, the escape occurred increasingly early although the cat could not be said to have learned to control the escape mechanism. It was this difference in approach which led Bertrand Russell to comment "Animals studied by Americans rush about frantically, with an incredible display of hustle and pep, and at last achieve the desired result by chance. Animals observed by Germans sit and think, and evolve the solution from their inner consciousness".

Today field psychologists think of behaviour as a function of the total situation, it is impossible to say to what extent behaviour is influenced by physiological or environmental factors; but both of these, including health and personality as well as the influence of other persons and the individual's view of himself must be taken into account in trying to modify his goals or motivate him to learn. They describe learning in terms of the individual sizing up, or interpreting, his world in a way that is meaningful to him, integrating experiences into existing organisations of knowledge, and using his environment in ways advantageous to him. It follows that what the individual perceives is selective. In teaching, therefore, they are concerned with motivation, stress the importance of arranging that learning experiences are organised into meaningful wholes, and favour the use of problem situations which enable the learner to gain 'insight' as he suddenly realises how to use information or how to interpret it meaningfully. In addition, the learner may develop and follow his own goals. The associationists, on the other hand, reject any introspective concepts such as 'goal' or 'insight' and concentrate their attention on changes in behaviour. They describe learning as built up by reinforcement of responses to stimuli in the environment. Consequently, it was not at first thought necessary that the learner should wish to learn but only that the teacher should encourage him to follow a logically organised sequence of stimuli; feed-back as to his success serving to reinforce correct responses. But the recent distinction between 'effective stimuli' for those relevant to the needs of the learner and 'non-effective stimuli' for those which are not is a modification which may open the way to allow for individual differences such as interests and motivations. Broadly, therefore, field psychologists concentrate attention on the learner, his attitudes, goals and interests, whereas associationists are more concerned with the structure of the subject matter.

Major contributions to the study of objectives have been made by psychologists of the associationist school in defining aims for the purposes of preparing objective tests or in planning programmes for teaching machines or programmed books. In both cases the psychologist begins by stating what behaviour the learner should be capable of at the end of a course or learning programme. For example, the vague aim 'to understand hypoglycaemia' is replaced by more specific statements such as: 'to list four principal causes of hypoglycaemia, to recognise the difference between acute and chronic cases, to describe the changes in the brain, to understand the mechanism, to list the minor causes, to differentiate between the lesions of acute and chronic hypoglycaemia' (88). Since the expert in the field tends to take these points for granted when he sees them (though he is usually rather slower to produce them), and it is only the student or someone less familiar with the field who immediately sees the advantage of having objectives spelled out in this way, we will give a similar break-down in other subjects. Croxton and Martin (28) who have prepared some forty programmes in strength of materials and theory of structures used the following objectives in a three and a half hour programme on 'axially loaded structural members made from two materials having different elastic and thermal properties':

(1) To recognise that the problem cannot be solved by statics alone and to understand the meaning of the term 'statistically indeterminate'.

(2) For a particular example with external axial loading:
    (a) to sketch a free body diagram,
    (b) to form an equation from statics,
    (c) to form an equation from the 'geometric fit' and to understand the meaning of the term 'compatibility',
    (d) to form an equation from Hooke's Law,
    (e) to solve these equations to find the stresses in the two materials.

(3) To solve similar problems extending the method to the consideration of thermal effects and 'lack of fit'.

(4) To solve more general problems using the same principles but which have more complex or unfamiliar configuration.

If, in this case, clear statement of objectives is no aid because the subject is so unfamiliar as to be meaningless, objectives in a section of elementary statistics should convince the reader that it is helpful to have exact requirements stated. J. Newsom of Nottingham suggests the following aims in studying reliability and validity. We must assume that his students are already acquainted with 'correlation'.

(1) To distinguish between validity and reliability by defining each but noting that each can be expressed as a coefficient of correlation.

(2) To distinguish different types of validity
    (a) face validity,
    (b) predictive validity,
    (c) criterion validity (including method of criterion groups),
    (d) construct validity (including factorial validity).

(3) To distinguish different types of reliability
    (a) test-retest (consistency),
    (b) parallel forms,
    (c) split halves (including Kuder Richardson).

(4) To note the relative advantages and disadvantages of these alternative methods and conditions under which each would be appropriate.

(5) To discuss the relationship between reliability and validity, and the way each is affected by 'test length', homogeneity of standardisation sample, speed vs. difficulty, etc..

Newsom remarks that "even with these aims it would be possible to cover the subject at different levels according to the statistical sophistication of the students".

Although this way of defining aims was first devised by the associationists, it does not preclude a student-centred approach in teaching; for, if the student himself is acquainted with so clear a list of objectives for every topic in the syllabus together with a list of references and has access to visual aids and specimens, it is possible for him to teach himself. Indeed, where this has been arranged, with free discussions between students, or between students and staff, as well as time set aside for periods of group discussion, students have acquired more information about a topic with more interest and in appreciably less time than by conventional methods (37). But the same objectives could serve equally in devising a carefully sequenced programmed book which all students would follow in the same order, if it was linear; or, again, they might be used to guide a more conventionally planned programme of lectures, demonstrations and individual study.

From these considerations it is evident that objectives in teaching are to some extent a matter of choice; teachers may choose to follow the field psychologists by maximising interest and teaching through problem situations, or the associationists in providing a carefully sequenced programme of learning, or they may follow the practice of many teachers and use either method with different aims in mind on different occasions. But, whichever they do it will be advantageous to describe fairly exactly in what ways the teaching procedure should alter the behaviour of the students.

Further aid in specifying objectives may be obtained from Bloom and his associates (18) and categories of aims similar to theirs. Their hierarchy of cognitive aims ranging from simple to complex behaviours should enable the teacher, or tester, to ensure that complex mental skills are adequately represented in teaching. Studies show that where lecturers do not deliberately include the teaching of complex skills, they tend to greatly over-emphasise acquisition and testing of information (81).

3. Analysis of objectives

Bloom and his associates (18, 19) made detailed analyses of categories of objectives in the cognitive and affective fields with a view to their use as goals in instruction and, in the case of cognitive goals to ensure the adequate representation of different aspects of knowledge and understanding in objective tests. Formation of a hierarchy of objectives in the cognitive domain proved fairly straightforward, for the defining abilities had received considerable attention from evaluators who had already identified the kinds of behaviours to be tested. In this domain, therefore, educational behaviours are arranged in order from simple to complex, in the belief that in the course of an individual's mental development a particular simple behaviour may become integrated with other simple behaviours to form a more complex behaviour. For consistency, each behaviour is placed in the most complex class which is appropriate and relevant. This provides a single order whether the reader accepts the view of the field psychologists, in particular those of the Gestalt School, that complex behaviour is something more than the sum of simpler behaviours, or the associationist view that the sum follows the usual laws of addition. However, it cannot overcome the difficulty in testing an individual that the nature of his prior educational experience influences the complexity of the test to him; thus a test item which is a matter of simple recall to a student who has previously studied this type of problem requires a complex problem solving ability on the part of someone wholly untrained.

The cognitive continuum begins with the students' recall and recognition of knowledge such as terminology, dates and events, conventions, symbols, methods, structures and so on. Although this is influenced by previous knowledge and by a conceptual framework - as we see if we attempt to learn symbols in our familiar alphabet or in a wholly foreign one such as Chinese - nevertheless, in testing, this objective normally requires little more than recall of information. Where higher cognitive objectives are not specified in teaching and testing there is a tendency to concentrate effort on this category and simpler kinds of comprehension. Since memorising information involves somewhat different approaches in teaching from the acquisition of mental abilities and skills it is of importance to clearly distinguish them. The latter differ in that the learner has acquired a capacity to do something with his knowledge other than merely to recall it. He learns to reorganise information or a problem, for example, or to use information in dealing with new problems and situations. All subsequent objectives may therefore be described as cognitive skills or abilities.

The second objective is that of comprehension. A student shows comprehension if he can translate from one medium to another, e.g. from a map to a model, from a formula to the statement of a principle, from symbols or diagrams to a verbal description, etc.. Or he may go beyond the data he was given, by interpolating missing data in a graph, making inferences from a passage he has read or generalising from specific instances. Or again, he can extrapolate by predicting further events in a sequence or by suggesting consequences of actions.

The third category of objectives is concerned with application of information. This differs in kind from comprehension because it involves appreciation of the nature of a problem and, possibly, restructuring it to solve it by known procedures. It is a common difficulty among poorer students of mathematics, for example, that although they comprehend relevant principles they are unable to apply them to any but familiar types of problem. However, if problems are complex and unfamiliar their solution involves abilities from a higher category of objectives.

The fourth and fifth categories, though different in kind are needed together for the solution of unfamiliar and difficult problems. In the first place, the student must analyse the problem into its constituent parts, recognising relationships between them. The ability to analyse is needed whether the problem arises in mathematics, chemistry, relations within a group of people or from a study of a patient's symptoms prior to making a diagnosis. In the second place the problem solver is usually required to synthesise his findings, together with information from other sources, to form a meaningful whole, or solution, to his problem. However, each of these skills could be employed separately: in a chemical problem analysis may be all that is required whereas in writing an essay for which the information is already available from different sources the main problem is one of synthesis.

Finally the sixth cognitive objective, evaluation, involves the making of judgments for some purpose concerning the value of information, ideas, methods or treatments, and materials, etc.. The evaluation may be concerned with external criteria of efficiency, economy or utility of specific means to attain a particular end, or it may be relative to internal standards of excellence such as consistency and accuracy or of logical rigour.

Contrasted with acquisition of knowledge, the cognitive skills and abilities are relatively permanent and transfer more readily to other situations. Consequently, teaching which emphasises mere acquisition of information is inefficient compared with that which, from the beginning, emphasises relationships,understanding of principles and their application, or their use in solution of problems. In addition, rapid advances in the scientific field put a premium on cognitive abilities and skills rather than information, because it is they which transfer to the understanding and use of new information or of new branches of knowledge. Further, there is increasing need for creative workers in science and technology who can go beyond the solution of familiar kinds of problems to the development of original syntheses. Although such an attitude is probably inborn or developed early in life, there is no doubt that teaching could foster it by provision of 'open-ended' problems and opportunities for students to work at problems of their own choosing. Moreover, their choice of problems and the method of dealing with them should enable teachers to recognise in a greater number of students some capacity for original work. It is of interest that expectation on the part of an employer or teacher that scientists or students will produce original work in itself results in their doing so, provided, of course, that the expectation is expressed. Gordon (43) in his book on Synectics mentions a firm in which a team of scientists failed to produce sufficient inventions for patent to justify their existence or to keep the firm flourishing. They concerned themselves with pure science and were not very productive. When it was suggested to the manager that he should tell them what he required, and he did so, a rapid stream of inventions followed. Similarly, with students, just giving them opportunity for originality and showing that it is valued appears to result in an increased output of original work (49). It is well known that some degree examinations can be passed very creditably by individuals with exceptionally retentive memories but little creative talent, whereas some of those capable of outstanding originality fail to do well. Poorer graduates could be selected as research workers if it was already known that they could go beyond familiar and partial solutions and stay with a problem, trying varied procedures on it, until they arrived at genuine and original solutions.

The affective domain necessarily impinges on the cognitive one. A student may find it impossible to analyse a problem objectively if it touches on his personal prejudices or if he has developed an emotional block towards it perhaps from discouragement; and he is unlikely to become a creative worker if his personality is such that he adheres inflexibly to views, standards or approaches which he has accepted from his teachers. Affective states are, of course, continuously operative among all students when learning no matter how ostensibly intellectual the content of their studies. Inescapable evidence of failure to solve mathematical problems for instance, is one of the most traumatic experiences to students who suffer it frequently. Demonstrable failure tends to depress effort, whereas success, or promise of success, and methods of teaching which give rise to a series of partial problems with sufficient hints to help the learner to recall or discover the principles which solve them, lead to increased application and interest. Training students to work independently, to solve their own problems, to extend or reorganise their knowledge as new developments are made, and so on, therefore inevitably involves affective objectives.

It is of interest that Bloom and his associates had difficulty in defining objectives in the affective domain partly because comparatively little evaluation had been undertaken within it (19). It would seem that although their equation "objectives = behaviours = evaluation techniques = test problems" was arrived at by equating certain behaviours, the equation is genuinely reciprocal; that is to say, if evaluative procedures cannot be found the behaviours are wrongly described and the objective is spurious or so general as to be meaningless. Nevertheless, to test affective behaviours reliably presents greater difficulties than the evaluation of cognitive behaviours.

The most important affective objective is the increase of motivation, or the inner incentive to learn. Various methods of doing this are in use: writers of programmed books provide many short term aims and reinforcement via immediate correction of the students' responses, whereas followers of the field psychologists set up problems for students to solve or involve them in projects which are of interest to them. But, in either case, motivation in learning is influenced by realisation that the work set will serve the students' ultimate goals and it will be increased by successful realisation of intermediate goals.

The hierarchy of affective objectives as outlined by Bloom and his associates is determined by the degree of internalisation of the affective state, ranging from a merely passive receptivity to organisation of values into a coherent whole characterising the individual. As a value becomes increasingly accepted by an individual he attends more actively to it, perhaps showing appreciation by an observation or comment. A second objective is that he should respond actively although initially the stimulus is an external one - he visits the museum, reads the assigned literature, or completes his homework; but as he grows more involved, he increases his activities voluntarily and obtains satisfaction from doing so. The third objective is that the learner should come to accept a value such as developing a continuing determination to speak and write effectively, an appetite for what is good in literature, or the wish to achieve accurate and well developed argument in writing a report. The fourth objective is that the student should organise his values into some kind of internally consistent system until, finally, the fifth objective is attainable - that of integration of his beliefs, ideas and attitudes into a total philosophy or world view. At this level there is inevitably a cognitive component; for the individual is accepting a value - that something is good for him and this is a judgment which goes beyond affect.

Probably the majority of teachers would feel that they should attempt to aid the student in the achievement of these objectives up to the third, but, unless teaching philosophy, might feel that the fourth and fifth objectives were outside the province of the university teacher. It is generally hoped that the university will provide the environment in which mature attitudes can be achieved and that the students will develop them; while attempts on the part of teachers to indicate a desirable integration of beliefs and values into a total philosophy would normally be regarded as propaganda. As we have seen, this involves consideration of the nature of education and the role of the teacher.

The findings of Inhelder and Piaget concerning the thinking of adolescents (60) suggest that the establishment of what he terms 'formal operations' at the age of about sixteen years involves a hypothetico-deductive method of thinking and the reference of opinions and judgments to general principles of behaviour. However, university teachers must be aware that these mature modes of thinking are by no means fully established in many students, so that the question remains whether it should be an objective at this level to induce students to think and feel in a mature fashion on a wide range of problems. The studies of Walton and Drewery (118, 119) show that the views of teachers are likely to differ, but we cannot set aside the problem of immature thinking in students destined for professions in which they influence other members of the public or are called on to make responsible decisions.

4. Objectives and university teaching methods

The work of Bloom and his associates in clarifying objectives has drawn attention to higher level objectives in the cognitive and affective fields which often receive insufficient attention in university courses and examinations. But there are other objectives not readily fitted into this or similar hierarchies which, nevertheless, have received attention from psychologists. We shall outline them briefly and at the same time consider research into their achievement. The outline which follows is not offered as a complete and ideal model but may serve as a basis for formulating fields of objectives.

(a) Effective use of staff and time

Experiments in this area have been concerned with the size of class which could be taught efficiently at one time in lectures or group discussions, or have made comparisons between methods requiring considerable or comparatively little staff time. De Cecco (29) found no difference in capacity to recall information whether students were taught in classes of 18 to 34, or in substantially larger classes of 97 to 127, but the students preferred smaller classes. In an experiment with chemistry tutorials reported by Cottrell (27) both staff and students preferred smaller discussion groups of 3 and 12 to those of 24 members; but those of 12 proved rather more successful than either smaller groups or larger ones. A saving in time was reported by Erskine and Tomkin (36) in an experiment substituting two periods of discussion for nine lectures during a three week course of anatomy. In addition students from the experimental group gained more information and were considerably more successful in oral examinations than were those who attended the lectures. Joyce and Weatherall (66) in comparing different methods of teaching - lectures, discussion groups, practical classes and unsupervised reading - concluded: "For tutors the size of classes is relevant to the economics of teaching, and the figures amount to 0.05 hour per session per student for practical classes on the same scale ..... these estimates ..... are probably reliable enough to emphasise the economy both to students and staff of lecturing compared with practical classes and discussion groups .....".

Programmed learning has also been used with the chief aim of economy in teaching time in the Armed Forces. In the Navy (109), for example, programmes in basic electronics and basic radio which were illustrated by film were used with the aid of a junior technician only. Students following this course instead of the usual course with the Instruction Officer did better than the conventionally taught groups taking 25 per cent less time in the case of radio teaching. In one experiment in the Army (116), a programme not allowing for practice and repetition proved as effective as a more detailed programme in Automatic Car Transmission System and was completed far more quickly.

A dramatic improvement in the ability to make dissections among students of biology has been reported in a personal communication by Goodhue of Trinity College, Dublin, who prepared tapes with diagrams and film-loops to show students how to perform the dissection of a rat, etc.. Following study of these aids, instead of the usual demonstration, students performed the dissection almost faultlessly in one hour, instead of taking the usual three hours and making numerous errors. It would be of interest in this case to investigate what factors were most helpful, e.g. the role of coloured diagrams, and to determine what kind of aids would give the necessary skill in a minimum of time or, alternatively, in a manner most likely to transfer to other dissections.

However, despite these evident gains, we shall see that more fundamental objectives in teaching should weigh considerably in the choice of method.

(b) The development of effective study skills

Study skills include speed and comprehension in reading, use of books and the library and visual aids, the taking of notes, writing of reports, organising revision and selection of the best methods of study. These skills tend to be taken for granted by many teachers, as though they were unalterable; but where experiments have been made to produce improvements in these respects, considerable gains have been reported. Barclay (9) used the Harvard films to train a group of adults to read faster and with greater comprehension. The average increase in speed was 81 per cent ranging from 213 per cent to 7 per cent. There was an overall improvement in comprehension and, after lectures on methods of skimming and scanning, a cut of about 50 per cent in time to find facts was achieved. Poulton (101) reviewed a large number of similar experiments with eight different adult populations. All gained considerably in speed and comprehension but, on re-test, after an interval individuals varied greatly in the extent to which they maintained the improvements, some doing so almost completely and others hardly at all. The studies of Jahoda and Thomas (62) already mentioned may result in similar considerable improvements in strategies of learning while reading.

(c) Promoting critical thinking and influencing attitudes

At first sight it may appear that critical thinking should be classified with cognitive skills rather than with attitudes although we have already drawn attention to an affective element in thinking. That there is an essential difficulty in thinking objectively owing to unconscious assumptions and habits built up in the course of learning has been shown by Abercrombie (1); reception of information, recollections, observation and description, judgments or inference are alike affected. Abercrombie experimented with undirected group discussions. Her aim was to avoid instruction in a 'correct' method but to develop a scientific method by stimulating students to work out problems among themselves by mutual questioning and correction. For example, in an early study with James and Venning (63), one group of students was trained to be observant in studying X-rays and other visual material, by criticism of their own descriptions and the receipt of visual information. In subsequent comparison of this group, with one conventionally taught, in observation of three X-rays, the trained group was superior to a highly significant degree; they made fewer false inferences, fewer inferences unaccompanied by descriptions, more of them considered two hypotheses rather than one only and a smaller number were inappropriately biased by one test in dealing with the succeeding one. Evidently a change in behaviour did occur due to this kind of general discussion.

The influence of discussion on attitudes and thinking has also been shown by Barnett (10), Hammond and Kern (47) where the presence or absence of case study discussion proved critical, Lewin (75) who found that lectures made practically no impression on the behaviour of housewives but that as a result of discussion a substantial number could be persuaded to change their food-habits, and Hallworth (46) who used interpretation of group discussions to make adult students aware of interactions, hostilities, etc. within the group.

That lectures may have little influence on critical thinking is suggested further by Elton's comparison of students attending lectures on logic with a group of psychology students; those 'studying' logic made no greater improvement in a reasoning test than did the psychology students (33).

(d) Oral skills

Oral skills are considered to be increasingly important objectives in departments such as engineering where young professional men may be called on to give lucid reports to people with little professional knowledge, or to talk impromptu about some possible new project. Both the capacity to put forward a view and understanding of the working of committees are therefore being taught. In departments where students are more specifically training to deal with people such as those of medicine, dentistry, and teaching, oral skills have always been emphasised. An inquiry into small group discussion methods in London University by Beard (12) shows that one objective in their use is the development of skill in reporting to a group or in chairing it.

(e) Special skills

Within the various university departments many skills peculiar to a field must be learned: for example, in medicine, skills in taking histories, making examinations, making clinical tests, interpretation of symptoms or diagnosis, etc. or in the sciences, skill in handling apparatus in the laboratory, in experimental methods, and so on.

The experiment of Goodhue, already mentioned in section 1, is relevant here as are experiments in evaluating skills by use of video-tape. For example, at Guy's Hospital in the Department of Pathology, video-tapes of students making physical examinations enable teachers to assess their performance at leisure but they also allow the students to view and to criticise their own performance and thus to improve it. In an experiment in the Physiology Department, students playing the roles of a doctor making tests, the patient and assistant were video-taped and this proved effective in improving students' performance both in making the tests and in communicating more sympathetically with their 'patients'.

Few studies have been made in their teaching; but, as with all skills, it is essential that the learner should have frequent practice and that he should receive constant feed-back on his performance.

(f) Acquisition of information

In contrast with skills which are learned by practice with feed-back, or attitudes which appear to be changed most readily in discussion, information may be committed to memory by a diversity of approaches. Successful experiments in improving immediate recall, or retention, of subject matter are based on what is known of remembering and forgetting in learning. It is known that to assist memory subject matter should be meaningful, interrelationships between topics should be stressed, and frequent short periods should be spent in learning in preference to a few long ones. Forgetting on the other hand, is induced by presenting the learner with many unrelated details, or by interference where a new topic is introduced at the end of a period of study or if two closely similar topics are learned together. To encourage accurate recall, correct responses should be rewarded, or reinforced, immediately (possibly only by knowing that the response is right while wrong responses should be corrected at once (28, 42, 52, 94, 109)). Above all, it is important that the student should make a response, overtly if the material is very unfamiliar to him (73); to be efficient his learning must actively employ his ability to organise new information into his existing mental schemata (53). Where learning takes place by rote, with little understanding, subsequent forgetting is rapid.

In using audio-visual techniques, recall is more efficient if repetition is possible (54), if more than one method is used (113), and if interference from note taking is avoided (7).

An experiment by Elley (32) suggests that making errors while learning has an adverse effect on recall of rote-learned material but does not affect the recall of meaningful material. He points out that in preparing programmed texts for students there is no need to be restricted by the assumption that errors should be kept to a minimum.

(g) Higher cognitive skills

Very few experiments have been made into the teaching of more complex mental abilities. Hayes (49) who studied the student dissertation reported that over a three year period there was a definite improvement in the handling of bibliographical materials. There was increased student participation in research and in the student research journal, 25 per cent of papers in 1961, 26.5 per cent in 1962 and 45.5 per cent in 1963 were based on original work. Collier (25) used work in co-operative groups to encourage critical thinking and to overcome the habit of accepting and memorising instruction. As with other skills, it seems that the higher verbal abilities and skills are developed by practice together with criticism.

A different approach to the realisation of cognitive objectives has been made by Gagné (40) and other associationists who have broken down subject matter into its constituent skills in order to recommend teaching methods appropriate to each one. Thus, if the aim is that of making multiple discriminations such as distinctions between terms, or formulae, it is imperative that the items to be distinguished should be well learned individually and that the tendency of interference between them should be overcome by repetition of the correct associations, or chains of associations for each item. It is then possible to bring them together to distinguish them with a minimum of interference. In learning concepts, on the other hand, bringing together a number of instances of the class, relationship, property or abstraction may suffice for the student to see what it is that they have in common; but he will also need to learn to discriminate negative instances and will almost certainly be aided by verbal description and he will find it essential in the case of abstract concepts. At the next level of complexity simple principles combine concepts as in 'masses attract one another'; but, in higher level principles, simpler principles may themselves be seen in relation to each other as in 'the force of attraction between two bodies is inversely proportional to their distance'. Organised knowledge consists of many such interrelationships. Successful learning, therefore, depends on the fundamentals being secure and lower-level principles well known, before the higher level ones are introduced. But in general, higher level learning of concepts and principles is very well retained, in contrast with associations and discriminations.

The highest cognitive objective discussed by Gagné is that of problem solving. To find a solution the student must know his goal and then select and use appropriate principles to achieve it. Katona (69) has shown that presenting solutions for students to learn is markedly ineffective in teaching problem solving, stating principles which should help is rather more effective, but a method of guided discovery which does not mention the principle and leads the student, by questions, to 'discover' it for himself is the most effective of all. Maier (84) found that giving instructions which recalled known principles assisted his subjects in solving problems. These findings may account for a difference noted by Beard (12) that mathematicians using small group discussions to ensure that students understood principles seemed more satisfied with the method than those who used these methods to work through specific problems.

In a recent study of problem solving in physics by students at an Australian university (26) they found great difficulty in dealing with unfamiliar types of problem and attempted to use deductive processes even when these were inappropriate. The writer suggests that thinking in problem solving should be made more explicit in a conscious attempt to improve it and that flexibility and inventiveness should be demanded of students in university courses. In England, this is already happening. At Imperial College and the City University for example, in new laboratory courses, students are required to solve problems of an unfamiliar kind even though they may initially lack a knowledge of the relevant theory.

Chapter 4. ARE OBJECTIVES REALISED? EVALUATION OF LEARNING AND TEACHING

Ruth M. Beard

1. The function of evaluation

Evaluation in the higher stages of education has two main functions - award of qualifications such as A-levels, diplomas and degrees which serve as entry to other courses or to professions, and provision of information, or feedback as to the success of learning and teaching. Traditionally, considerable attention has been given to the former, whereas the latter has been left to the devices of teachers and students who have often provided or obtained information too late to make learning more effective. For many years proposals for reform have been in terms of adjustments to the examination system or demand for better selection. Extensive researches were set up to relate students' performance at entry with their achievement in finals, usually with no reference to the organisation of courses or to the teaching which came between. It was hardly surprising if they ended in selecting good examinees among the less able students. Even today, it is the abilities of the students, rather than the quality of teaching and learning in a school, which are criticised when students fail; interestingly, when students do well their teachers are commonly given the credit by their colleagues - it is the teachers of other schools who point to the exceptional calibre of the students!

The more recent concern with the systematic study of teaching and stress on educational technology promises to place the emphasis where it should be: on the improvement of learning. Moreover, teachers and psychologists who have studied examining techniques point out that to include all the skills and abilities which should be tested and to arrive at more reliable assessments requires substantial changes in examinations. Although in the long term, this must involve acquisition of qualifications, there is no reason why a qualification should be given for performance in examinations taken on one occasion, or within a short interval. On the contrary, evidence accumulates to suggest that in evaluating skills, for instance, some form of continuous assessment is more satisfactory. Intermediate objectives may still be assessed by performance in specific tests, projects, essays, reports on series of experiments, etc.; but short term objectives need altogether more attention such as immediate comments on students' performance of skills, questions to be answered on current work, or during a lecture, discussion with students of the experiments they are performing or problems they have attempted, and so on. And, since teaching time is limited, aids to learning must be devised to enable students to correct their own performance or have it corrected by machine or unskilled helpers.

In addition, the teacher himself needs more evaluation of his performance than he has formerly had. Various methods of obtaining useful information are being explored by employing modern audio-visual techniques, or by consultation with the students themselves. For example, use of videotape enables the lecturer to see himself in action and so to monitor his own performance, while students' opinions on teaching may be obtained by use of questionnaires. In these ways, it is hoped that teachers will be enabled to give maximum help to their students and, possibly, to channel their efforts into the teaching skills which they perform best.

2. Techniques in examining and testing

Since space does not permit us to take a sample course, to break it down into objectives and to indicate how we consider attainment of each objective might be evaluated, we shall discuss various evaluation techniques leaving teachers to reconsider their relevance in their own subjects. Claims for each technique and criticism arising from research will be briefly discussed and references will be given to more extensive research findings.

(a) Essay writing

Criticisms of essay examinations are usually advanced on the grounds of unreliable marking and consequent difficulty in making fair assessments of students. A less frequently mentioned criticism is that they may be used where essay writing is irrelevant, in assessing skills which are mainly practical, for example. Beard et al. (11) observed the high correlations between scores in a test of verbal ability and examination scores in dynamics, engineering drawing and 'strength of materials' in an engineering department at Birmingham and questioned whether perhaps the examinations were too verbal for the skills they were intended to evaluate. Certainly there are departments which use essays as an examination technique in finals although none have been written throughout the preceding three-year course. This suggests that a serious review of objectives should be undertaken to ensure that the form of the final assessment is fully relevant to what students are supposed to learn in such courses.

Considerable evidence has been collected which shows that the marking of essays tends to be unreliable: examiners often differ substantially from each other in the marks they assign, and even the same examiner may differ significantly in the marks he gives to the same set of essays on two occasions. Much of the evidence is surveyed in the Universities Quarterly of June 1967 (112). To give but one example: Bull (21) calculated correlations for two examiners with themselves in marking a set of essays on fairly factual medical subjects and found them as low as 0.28 and 0.42. The mean marks given by the two examiners correlated 0.34 with each other. In other words a chance assignment of marks would have been almost as effective a means of assessment. He concluded that the essay paper of the kind in which four questions were to be answered in three hours was very inefficient in distinguishing between students.

Those who value essay examinations have sought ways of arriving at more consistent standards of marking. Bull (21) found that greater reliability could be obtained by using more examiners and averaging their marks for each paper. The mean marks of four independent examiners used in this way raised the consistency to 0.9. Although there is an advantage in a plurality of markers, there are two objections to this method: there is not usually a sufficiency of examiners to have every essay marked independently four times, and averaging marks can obscure those interesting cases where examiners have difficulty in agreeing and which probably, therefore, deserve individual discussion.

Other modifications in essay examinations have been proposed and are in use in some universities. These include announcing the examination topics in advance so that students arrive prepared at the examination or allowing students to bring their books to the examination room with them. These methods are reported to result in much the same rank order of the students but in a generally better performance. An increased time allowance may be needed to overcome the problem of a student who thinks profoundly but rather slowly.

Although the variation in standard between examiners is greater in some subjects than in others, and may be slight where teachers from one school mark the papers, for they are likely to share similar views of both subject and students, nevertheless it seems that much of the confidence expressed in existing essay examinations is misplaced. Even where teachers agree closely this may arise less from common objectivity than from a shared bias such as the 'halo-effect', for example. As early as the 1920's it was recognised that teachers tend to rate highly all performances of students they agree to be 'good' whereas they tend to give low marks to students who are considered 'poor'. (122) Tales of students who exchanged essays written in term time and found that each, nevertheless, received his customary 'A' or 'C' are not wholly without foundation. Internal marking in finals tends to confirm such biases.

Attempts to agree on a marking system assigning marks for particular information, for knowledge of principles, etc. and with an agreed bonus for originality go some way to producing greater consistency when candidates all attempt the same questions. Stalnaker (108) who used such a method in marking school essays achieved a correlation between markers of 0.85; but when questions were longer and more involved, as is commonly the case in higher education, consistency dropped to 0.58.

As a method of learning, however, it is generally agreed that essay writing is effective, and for this reason, if for no other, it would perhaps be unwise to exclude it from examinations for there is a tendency among students to judge unimportant what is not examined. Simply to write an essay on a well-chosen topic obliges the student to collect information, to organise it, to weigh evidence for different views and to find words in which to express them. Even when little criticism is given this is likely to assist clarity in thinking; but if, in addition, it receives the kind of detailed criticism which is realised in an ideal tutorial it will lead to the student becoming aware of his misconceptions and limitations and so lead him to greater objectivity and breadth in thinking. Since the ratio of staff to students does not allow frequent tutorials in the majority of colleges, there is a tendency to give uninformative grades. But this can be avoided without excessive labour if teachers devise a scheme enabling them to write detailed criticisms on each student's essay, perhaps in the form of agreed symbols, or if they take a few essays from time to time, analyse their content, and make clear their merits and defects for the benefit of an entire group. In this way, students receive information as to their performance and guidance for future improvement. On balance, therefore, the essay appears capable of making a valuable contribution to the student's thinking and capacity to arrange his ideas but a cumulative assessment of the student's essays over a period of time might well be more reliable than the results of essay examinations.

(b) Objective tests

The type of examination most favoured as an alternative to essay examinations is the multiple-choice objective test. When first devised these tests tended to be limited to items requiring merely recall or recognition of information and, in consequence, there was considerable antagonism to their introduction in higher education in England. In the late 1950's and during this decade, however, new types of test have been devised and educational taxonomies have been employed to decide on suitable categories of cognitive skills before the tests are prepared. In an investigation into an existing multiple-choice examination in 1961, McGuire (81) decided on an eight-level classification: recall of specific facts, abstraction of principles, selection of appropriate generalisations to explain phenomena, interpretation of data presented in a variety of forms, application of principles to solution of problems of a familiar type, analysis of unfamiliar constellations of events, evaluation of a total situation and synthesis of data into new and meaningful wholes. At that time she found that some 78 per cent of the items in National Board medical examinations fell into the lowest category of 'isolated recall', 5 per cent required recognition of meaning of a fact or concept, 11 per cent involved ability to generalise, leaving 7 per cent only in the remaining five categories, of which 'unfamiliar applications' and 'ability to synthesise' remained unrepresented.

Today anyone undertaking to prepare such a test decides on his categories in advance assigning to them agreed numbers of items within each topic. For an A-level physics test devised at the Institute of Educational Technology in the University of Surrey, the following grid was prepared:

	Knowledge	Comprehension	Application	Analysis/ evaluation	Total
Gen. Physics					15
Heat					11
Light					11
Sound					8
Elec. & Mag.					22
Atomic Phys.					8
Total	19	34	15	7	75

From the totals it is possible to work out approximate numbers of items to be devised in each category. Thus in Atomic Physics, 19 x 8 ÷ 75, i.e. 2 approx. of the total 75 items should come in the 'knowledge' category.

Items themselves may take a variety of forms. Those most favoured offer four or five choices to the examinee, providing plausible alternatives to a correct answer or asking the student to find an exception, e.g.

> "All of the following are factors known to upset the Hardy-Weinberg Law (of genetic equilibrium) EXCEPT
>
> (A) population size
> (B) natural selection
> (C) random reproduction
> (D) genetic drift
> (E) migration "

The normal criticism of this type of item is that it is possible for the student to guess a proportion of answers correctly and that, if the options are not very carefully prepared, there may be cues to wrong ones (for example, if they are too sweeping in asserting 'all....', 'always....', 'never....', etc.) or to the correct one if it is conspicuously more carefully phrased than the others. However, there are avoidable features of test items and guessing can be penalised by subtracting a proportion of the score for wrong answers if this is felt to be desirable.

Although the difficulty level of the majority of items in tests is not high, their difficulty should be determined in accordance with the aims of the test. The form of the question can be altered to make it more complex - and to add to the odds against guessing correctly - by a series of cross matching statements. For example, the following item suggested by Bloom and his associates (18), in the category of application, would give occasion for some hard thinking at least to weaker students in elementary astronomy:

> "You have acquired some knowledge of the earth and its motions as they really exist. In this exercise you are to identify the effects of some wholly imaginary conditions. After each item number on the answer sheet underline the appropriate letter:
>
> A- if the item would be true if the earth were not inclined on its axis
>
> B- if the item would be true if the orbit of the earth were a circle rather than an ellipse
>
> C- if the item would be true if the earth revolved toward the west rather than toward the east
>
> D- if the item would be true if the earth had half its present diameter but retained its general mass
>
> E- if the item would be true if the earth had no moon.

Assume only one of the above imaginary conditions occurs at a time.

1. All the solar days would be of equal length.
2. Objects would weigh four times as much as they do now.
3. The celestial equator and the ecliptic would be identical.
4. The sun would set in the east.
5. A different North Star would need to be chosen.
6. The force of gravity would be four times as great.
7. The orbital speed of the earth would not vary during the year.
8. We would know less about the nature of the sun.
9. Night and day would be of equal length in all latitudes all year long. "

It must be evident, even to those who have not attempted it, that the chief expenditure of time in preparing these tests is in designing promising questions whereas the selection of items and their marking can be at least partly achieved by computer methods; the latter may be done by machine for large numbers of candidates, or very rapidly, by someone unskilled, for smaller groups. To reduce time in setting them, co-operative efforts are desirable. When a 'bank' of several thousand suitable items has been collected it is possible to feed data to a computer and to programme it to select alternative tests of given difficulty levels, covering stated topics and categories of cognitive abilities; even the reliability of the test can be specified once the items have been adequately tried out among a population comparable with that to be tested and norms can be computed.

Further advantages of these tests are that results can be obtained rapidly - students receive their grading on the same, or the next, day, in time to revise for a further test if necessary. Moreover, although the 'bank' of questions must not be circulated, similar items serve to make very effective tests for revision or for testing at the end of a lecture or short course. Since there is little to write, a large number of items can be answered in a very few minutes. At Sussex, for example, lecture notes and multiple-choice tests with answers are circulated simultaneously.

Currently, in America, attention is being given to the development of new types of objective examinations to test higher cognitive skills. In the medical field, where considerable progress has been made, the tests require the students to interpret information or to make judgments of the kind they would have to make as physicians (13). As with other objective tests, when an item analysis is made, it is easy to identify specific strengths and weaknesses of individuals and to follow progress over a period of time or as a result of curriculum changes. Initially, at least, the help of a psychologist or a specialist in Education is likely to be needed in devising and marking more complex objective tests.

(c) Short answer tests

The short answer test has the advantage of requiring recall rather than recognition of a correct answer and so is well suited where information must be known. Such questions may consist in giving definitions of terms, making labelled diagrams with brief notes, providing lists of, for example, procedures in dealing with a technical fault or reasons, in order of preference, for choice of a medical treatment. Some attempt may also be made to combine the merits of essay writing with those of brevity and the objectivity of multiple-choice tests. For example, medical students may be asked to answer a multiple-choice question putting in order the steps in the aetiology of a condition, and then to outline briefly its treatment. Or a brief description in a few lines of essential features may be asked for. This has the merit that the student must show some ability in organising information, but the brevity of the answer allows for a comparatively simple and objective scheme of marking.

(d) Oral examinations

Oral examinations have been the traditional method of examining in some European countries; but to provide as many as six (or even more) examiners and to ask candidates sufficient questions, or sufficiently searching ones, to test their knowledge is too time consuming where the number of candidates is large. However, since an engineer, for example, will often need to give verbal explanations of his plans and to defend them in argument, there is a case for emphasising verbal skills in teaching and examining.

Like essays, oral questions tend to be an unreliable method of examining. Bull (21) found that, in oral medical examinations, agreement between two examiners testing the same candidate on the same patient was good but became somewhat less so when candidates were tested with different patients. The oral examination has the disadvantage, also, that a clash of personalities between examiners, or between examiner and student may influence results. One external examiner reported recently that as a student entered the room the internal examiner remarked audibly "This one needs taking down a peg!" The external examiner compensated for this initial disadvantage to the student by asking easy questions only but was involved subsequently in a long argument with the internal examiner. In such a case one sees the need for the large number of examiners sometimes used in European oral examinations; but it seems probable that factors other than skill in the subject such as the 'halo-effect' and verbal fluency play a part in any oral examination.

New techniques offer to make oral examining more objective now that, in certain cases, a permanent record can be obtained on tape or video-tape. Discussion between a linguist and the examiner, or a medical student taking a history from a patient can be recorded and examined again at leisure. In either of these cases, the record can also be used to demonstrate his own faults to the student; for, like most good methods of examining, it is also a valuable aid to teaching. To increase objectivity in evaluating the student's performance, an analysis of the behaviours the student should demonstrate needs to be undertaken beforehand so that each one can be assessed separately. In this way, the danger of influence from 'halo-effect' which is at a maximum in an overall, unanalysed judgment, is at least reduced.

(e) Examining practical skills

The examination of practical skills is a prime concern of dental and design departments and, to a lesser degree, of medical schools. It may also be of some importance in the assessment of scientific experiments. Although in industry the teaching of practical skills, and their evaluation, has received considerable attention, no detailed analyses of skills in university teaching have been reported. There are, of course, two types of skill: those to which knowledge of results is automatic or 'intrinsic' and those in which some additional 'extrinsic' information must be supplied by an instructor. In the former, even the beginner can see, or feel, that something has gone correctly into an assembly, or is wrongly placed, etc. but in the latter, as when a medical student begins to make physical examination, he needs advice on what to feel for, how to place his hands, etc. and would be unable to learn without it. Thus the student can assess his own skill in the former case but an instructor or examiner is necessary in the second.

It seems probable that new techniques will assist also in assessing skills. Video-tape, for example, allows the student to see his own performance or the examiner to view it again. Experiments in some London hospitals suggest that this is of greatest value to the student, but a collection of permanent records will also serve as a basis for analysis of skills, or of errors while learning them, which should lead both to more rapid learning and to increasingly accurate assessments.

(f) Problems, experiments and projects

Solutions to problems and ability to perform experiments have always been an essential part of mathematical and scientific examinations; yet, if a university teacher seeks for even a single publication in Britain to assist him in setting better problem papers or in assessing experimental work more objectively he will do so in vain. No-one has prepared categories, such as Bloom's as a guide to the kinds of skills which are required in solving problems or to aid in setting examination papers which draw on a variety of such skills rather than almost exclusively on low-level ones, or those which happen to interest the examiner. In some ways, examinations consisting of problems and experiments should be the easiest to assess since the test is whether the candidate solves the problems or completes the experiment successfully. But in mathematics examinations there is evidence that students' performances in successive sets of papers may vary considerably. For example, Dale (30) reports of candidates who failed an examination in June with marks of 27, 25, 32 and 36, that in September they received 58, 63, 59 and 76 respectively, while the marks of one student varied from fail to first-class standard in a series of examinations. This may well be because different skills are required to a greater or lesser degree on different occasions. Until skills in problem solving have been analysed and identified there seems little hope of any substantial improvement in either teaching or examining it.

Introduction of open-ended experiments and projects adds further difficulties to applying traditional kinds of evaluation. Since examining is rather unreliable even when students perform the same experiments, it is inevitable that when they perform different experiments, write on different topics or justifiably reach different conclusions in an open-ended experiment, evaluation on a common basis is almost impossible. In Chapter 1, however, we considered the analysis of an industrial design course into objectives to be attained at different stages of the course or within different projects. This is, at the moment, the most promising way of establishing common criteria in creative work and points to the need for teachers in higher education to specify their objectives in teaching with much greater precision. A series of assessments for each student also overcomes to some extent the unreliability of giving a final grade for a single piece of work.

3. Continuous assessment

The term 'continuous assessment' may be used either of assessment designed for the benefit of the learner who continuously gets feed-back on his success in learning, or of a system of testing and grading designed for the information of teachers. In the former case, it may take the form of programmed learning, test questions on topics recently learned, discussion following questions, fairly detailed criticism of experimental work, reports or essays, etc.. In the latter, it is more likely to consist of tests every few weeks which are intended to have a motivating effect on students - since failure to work will be demonstrated, and abler students, at least, compete for high positions. Either kind of assessment may - but need not - give some indication as to the effectiveness of teaching.

In some subjects it is possible to plan periods of teaching so that learning is evaluated. One method, originally tried out in a postgraduate medical course (89), has since been used in London with good effect. This consists in giving a shortened, well planned lecture, stressing principles, before setting a few questions or problems which students answer individually; these are then discussed between neighbours, differences being resolved by looking up points or in argument. Finally, any outstanding difficulties are put to the lecturer. There are several advantages to such a method: firstly, the normal period of one hour for a lecture has been found too long for students to give their full attention (79), secondly, many psychologists have shown that any method which involves the active response of the learner results in more effective learning and, thirdly, by joining different groups the teacher can discover for himself what students find difficult to follow. In this way learning and evaluation proceed hand in hand.

The development of computer-assisted teaching increases the possibility of giving 'feed-back' to the learner and responding to his particular skills or difficulties. Since it is even more adaptable than programmed books and teaching machines it should lead, like testing in teaching, to highly effective learning. For it has access to an amount of information which would be excessive for any one teacher to recall, and on this very broad basis of accumulated 'experience' can make 'decisions' as to the appropriate further route in learning for each student. However, it remains to see how long students will be interested to learn in so impersonal a manner and whether some types of students - perhaps the most creative ones - will prefer to follow their own devices. Even without this development it seems likely that undue emphasis on individual work throughout our secondary and tertiary systems loses much of the value of argument between equals and therefore, of the learning which takes place during discussions between students.

The alternative, or additional, policy of employing kinds of continuous assessment consisting of tests where the students are given the results but do not know their errors promptly, has less to recommend it. Although this puts students under pressure to work hard and to make constant revision, tests are liable to arouse excessive anxiety in a few students and may encourage an attitude of 'getting by' or studying how to obtain good grades rather than to master the subject. However, the 'cheerful extroverts' among students may require such a stimulus to make them work; usually only the introverts become excessively anxious. It is, therefore, for the teacher to judge the personality type of his students and to use frequent tests which are graded if this seems desirable.

Both teaching staff and students have mixed attitudes to assessment of course work as part of a yearly grade or final qualification. Those who argue in favour of it perhaps have in mind that work should proceed by the first kind of continuous assessment. Teaching staff against it tend to feel that course work is often not the unaided work of the student and that this kind of assessment is, therefore, unreliable, while students opposed to the inclusion of marks for course work in final grades point to the low marks some teachers habitually give or to cases where student and teacher are at loggerheads and low marks are given deliberately by an offended member of staff. However, such difficulties do not always apply and, if continuous assessment is felt to be important - as in teaching skills - problems of uneven or unfair marking may be overcome by requiring more than one member of staff to make assessments. Meanwhile, where course marks are allowed in a final assessment they normally count for a small proportion of the total marks. Until more objective methods of assessing learning and performance are available, perhaps via computers, it seems desirable to use course work to provide feed-back on learning. If it is employed for purposes of evaluation for qualifications its shortcomings need to be borne in mind.

4. Evaluation of teaching

The evaluation of teaching presents many problems since individuals differ in their performance on different occasions, with different groups of students, and in teaching different topics; but to provide 'feed-back' on specific performances is a simpler matter and is likely to have an immediate beneficial effect on teaching.

In London University several methods are fairly commonly in use. A number of lecturers make a habit of taping their sessions of teaching and listening to them subsequently. They report that this helps them to be critical of their delivery of lectures, the kinds of questions they ask or comments they offer in discussion, etc.. A few lecturers, in addition, invite colleagues to attend their sessions of teaching and to offer their criticisms. The most effective method, so far, however, seems to be the use of a questionnaire such as that prepared by teachers from nine science departments (14); this is designed for students to fill in their comments on a particular session of teaching early in a course. Main headings refer to extraneous factors such as noise, temperature, etc., delivery of the lecture, its content and organisation, and the use of visual aids. Since this kind of evaluation takes place early in a course it is possible to modify teaching in good time to meet students' difficulties. All the students have to do is to underline one of five comments such as:

Material very clearly and attractively presented	Material well presented	Satisfactory	Untidy. Rather crowded. Partly illegible	Far too crowded. Illegible.

but space is provided for additional comments and this is normally used. Teachers say that their students take the request for their views very seriously; those who have reported, in detail, mention comments on unsuspected inaudibility at the periphery of a lecture room, requests for more illustrations, for more applications of theory, or for a slower pace when notes must be taken; students of electrical engineering stated a preference for circuit diagrams in colour rather than in black and white. Response to these comments and requests has resulted not only in more effective teaching but in much improved rapport with classes. Even where teachers believed that staff-student relations were already very good some have been surprised at the difference made by the use of the questionnaire. They comment on unexpectedly better co-operation from their students who converse with them more freely and become more obviously interested in their sessions of teaching.

Other methods of evaluation arise from the use of new techniques. Most valuable is the careful analysis of objectives in teaching, such as that which is undertaken in preparing programmed books, for this draws attention to points which may previously have been neglected. Everyone who breaks down a topic into its successive objectives - putting it into the best order for students to follow and writing frames which will enable them to work quite independently - discovers how much he has been accustomed to taking for granted in talking to a class, either as to their knowledge or data which they can manage without. Some teachers who have progressed no further than this in writing programmes report that the exercise has radically altered their approach to testing.

Objective tests and examinations should also provide evaluation of teaching if detailed results are available to teachers. In this way it is possible for a teacher to find out how well students answered questions relating to subjects he taught them. It is astonishing that it is not universal practice to make results available to teachers ; yet on the contrary, it is sometimes impossible for teachers to obtain them even though they wish to.

One way to obtain immediate information as to students' understanding of a topic is to ask multiple-choice questions in a 'feed-back' classroom. At the Royal Veterinary College, for example, an electrical system has been devised so that when students select one of four buttons to press on their desks their choices are shown on a panel on the lecturer's desk. This enables him to see whether they know the correct answer or what proportions choose different erroneous answers.

The use of television and video-tape has scarcely been tried but it has obvious value in allowing a teacher to see how he looks in front of his class and whether he is making sufficient contact with them. Perhaps the use of two-way television (in an experiment by R.F. Mager reported by a visiting scholar) in which students worked in cubicles and could turn off the teacher when they wished would be beneficial in training. Mager found that teachers explained points at too great length so that students lost patience yet the teachers continued their explanations to the end even when students had switched off!

A further possibility of new techniques in training was explored by Kersch (71) who used film or still pictures and a sound track of sixty classroom situations during the first three days of student training. Student teachers were required to behave to the screen as they would to the class, pictures and sound volume being changed in accordance with their behaviour. In this way, Hawaian student teachers who normally speak too softly were rapidly trained to raise their voices, and other desirable behaviours were fairly quickly induced. Small, still pictures proved more effective than moving, life-size ones, perhaps because there was less to take in at once. Possibly the 'treatment' for a new university teacher who spoke too quietly or dully would be to see pictures of the 'class' walking out, whereas if he was interesting and lucid successive pictures would show the class increasingly attentive and enthusiastic; but so far this method of supplying continuous 'feed-back' to the teacher in training has not been tried in Britain.

Conclusions

In concluding this survey of evaluation techniques, we must stress that those discussed here are not adequately related to the objectives which we considered in Chapters 1 and 3. This will inevitably be the case until objectives have been defined in detail and with sufficient clarity to provide a basis for comprehensive evaluation of learning and teaching. There is no doubt that interest already exists in the university schools, but the volume of work involved in undertaking a detailed, and perhaps controversial, examination of objectives is formidable, nor can it be undertaken by an outsider. It must involve the teaching staff; for, however helpful a psychologist may be, he is unable to specify the objectives of other teachers in an unfamiliar field and, in any case, for the objectives to be fully meaningful to the teachers they must share in defining them.

Already there is an appreciation that in practising skills, or in learning information and principles, prompt 'feed-back' is desirable and that it should indicate not only what errors to avoid, but how to improve performance still further. There are a number of experiments in progress which are beginning to reach the point where departments can combine in preparing tests, in using and writing programmed books or sharing experiences of introducing open-ended experiments and research projects. As co-operation of this kind increases, ability to assist and to evaluate different kinds of learning will accelerate. In addition, it may lead to the development of new ways to evaluate learning as fresh objectives are identified and defined.

From the preceding discussion, it is also evident that there is much research to do. There are many skills and abilities which we neither teach nor evaluate adequately. We need to investigate their nature more fully and to devise techniques to evaluate successive steps in realising them. It is pleasant to imagine a research centre which could undertake this for all university schools and certainly more research staff would be valuable, but we have already observed that, in higher education, psychologists may not fully understand the objectives of the teachers since the subject matter in other fields is too unfamiliar. But, in addition, there is a great deal to be said in favour of the teachers themselves (or at least a proportion of them) being involved in developing new teaching methods and techniques of evaluation; for, in this way, they apply them with full understanding which can readily be shared with colleagues and, in seeing the resulting improvements in learning and teaching, all become more enthusiastic. Thus it seems probable that co-operation between teachers and relatively few psychologists and professional educationalists within the institution will be the most effective aid to progress.

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